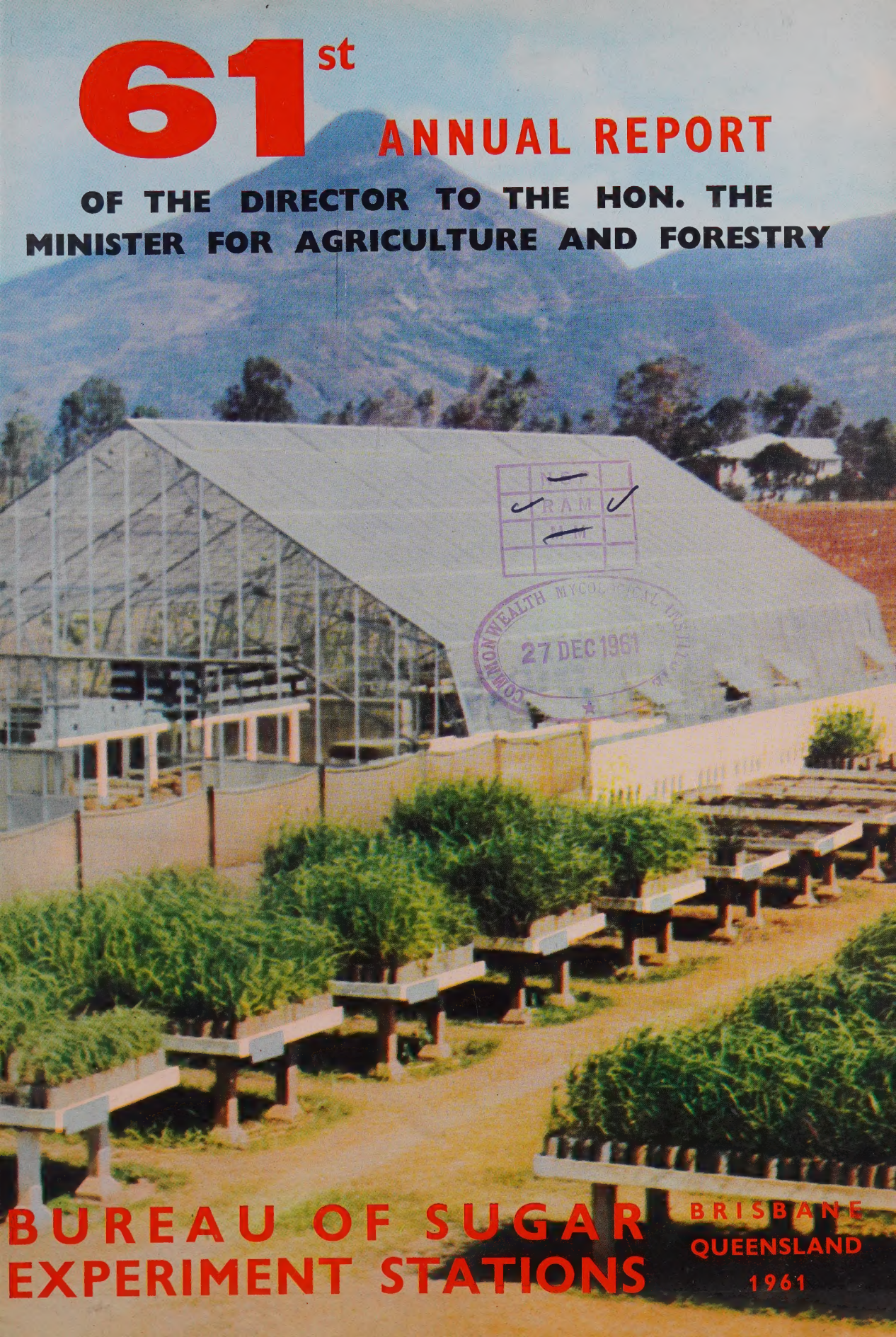
61st ANNUAL REPORT

OF THE DIRECTOR TO THE HON. THE MINISTER FOR AGRICULTURE AND FORESTRY



BUREAU OF SUGAR EXPERIMENT STATIONS

BRISBANE
QUEENSLAND
1961

61ST ANNUAL REPORT OF THE BUREAU OF SUGAR EXPERIMENT STATIONS

(As required by "The Sugar Experiment Stations Acts 1900 to 1959").

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Our cover: At Meringa Experiment Station Walsh's Pyramid forms a pleasing back-drop for the glass-house and the potted sugar cane seedlings.

A Bundaberg seedling, 53S47, which performed remarkably well during the 1960-61 year.

Above—Part of a 40-acre planting of Malabar pea at Clare, near Ayr. This is a seed crop to supply cane growers.

Left—Q.68 Plant cane on the Herbert R., 1961. This variety is finding a place on certain soil types.

Below—L.74 shows vigorous growth on the Ingham Line area, 1961. It may be the next Bureau cane to receive a "Q" number.

Sixtyfirst Annual Report of the Director of Sugar Experiment Stations to the Honourable the Minister for Agriculture and Forestry

Dear Sir,

During the past year, the progress of which is reviewed in this report, the Bureau of Sugar Experiment Stations functioned normally and successfully as the official research and extension body of the sugar industry. The Bureau's administering body—the Sugar Experiment Stations Board—met on several occasions during which it made, extended or approved policies aimed at improving conditions, services and operations of the Bureau. The cane growers of the State were represented on that Board by a new member during the year, Mr. A. G. Mann having been nominated by the Queensland Cane Growers' Council for a three-year term.

The Bureau has, for a long time, followed the principal, traditional lines of investigation in the fields of cane breeding, insect-pest control, disease control and eradication, plant nutrition, general agronomy, and sugar mill technology and engineering. But new branch lines of research are being introduced each year. At the present time these include basic research into certain diseases, control of newly-discovered insect pests, the incidence and effects of parasitic nematodes, legume breeding, saline soil conditions, and the investigation of certain nutrient deficiency problems. The major part of mill technology effort is concentrated on the investigations of your Joint Committee on Cane Analysis.

The wide range of climatic environment encountered in the sugar producing districts is an obstacle of considerable magnitude to applying results of research on an industry-wide scale; and, superimposed on the weather complex are extremes of soil variation to complicate the problem further. For these reasons many investigations must be pursued in all major districts. The benefits of legume fallows in supplying the subsequent cane crop with adequate nitrogen are proven in most districts but are conjectural in others; any benefits from trash conservation have been disproved in one area—following results from a twenty-eight year experiment—but the proof cannot be accepted as applying universally; an increase in crop growth following soil fumigation can be accepted as applying only to a particular area on a farm and is not necessarily acceptable elsewhere; and, of course, varietal testing must be conducted district by district. Many other examples could be quoted to illustrate the multiplicity of parallel investigations which are necessary and desirable.

To meet this position in some degree, and to accede to the wishes of the industry, the Bureau maintains field staff in eight centres in the sugar districts, and conducts its field investigations not only there, but in all other mill areas as well. This wide spread of personnel, facilities and services has been made possible only because the industry, although ready with demands for service, has never objected to the financial outlay necessary.

Information which was collated specifically for the Sugar Enquiry Committee disclosed that, of the industry monies devoted to research and extention, approximately £250,000 was expended by the Bureau of Sugar Experiment Stations and £110,000 by the various Cane Pest and Disease Control Boards. Eighteen out of twenty-one of these Boards are established, and operate, under the Sugar Experiment Stations Acts. The sum of these two amounts may therefore be accepted

Excellent pod development on Malabar Pea. This variety is being recommended by the Bureau for wet areas where resistance to wilt is important.

as approximately the contribution by the growers and millers of the State to Bureau-directed research and extension. The Bureau receives an annual subsidy of £7,000 from the Queensland Government.

The Bureau's contributions to the sugar industry over the period of its existence have, by their very nature, been in the field of applied research. They have covered such matters as insect pest control, disease eradication and control, breeding and introduction of new cane varieties, development of improved fertilizer usage, the discovery and commercialization of new legumes, better cultural practices, improved weed control methods, and technical advances in all phases of raw sugar manufacture.

However, the Bureau's apparent emphasis on applied research should not be construed as being at the expense of fundamental or basic research. Many of the results achieved in more recent periods had their origins in the earlier basic studies in the realms of zoology, entomology, pathology and chemistry, and work in some of these fields is still continuing. Basic research is also being conducted in the field of selection procedures which are applied to the very large numbers of sugar cane seedlings, to ensure that the percentage selected for further testing will contain the best individuals.

The opinion was recently expressed in an Australian scientific editorial that one per cent of Australia's national income should be devoted to research, and that it should be provided through the channels of industry, university and government. If this thesis be applied to the sugar industry, which has a current output valued at over £60,000,000 it will be found that the industry alone provides and spends about 1.3 per cent of that sum on its agricultural and milling research and extension; that percentage includes the amounts mentioned above as covering the work of the Bureau and the Cane Pest and Disease Control Boards, as well as the sugar research budgets of the Colonial Sugar Refining Co. and Sugar Research Ltd. The sugar industry is probably the only primary industry in the Commonwealth to spend so generously from its own funds and to conduct, virtually unaided, its own research and extension programme.

In the foreseeable future there are several avenues of investigation which will justify work of a fundamental or applied nature; these include such matters as further rat studies, plant nutrition, sugar cane genetics, legume breeding, improved weed control, and investigations into some diseases and insect pests.

The valuable work conducted in the thirties and forties into cane-field rats formed the principal basis for present-day rat control methods but the work should now be extended to other species and to particular environmental problems in certain districts. The correlations between soil nutrients analysis and fertilizer requirement, as established by the Bureau thirty years ago, have stood the test of time but it may be of value to measure them against the criteria established by other techniques, and that is now being done. The very wide and complex range of genetical material

Irrigated pastures and cattle on a cane farm at Homebush, near Mackay.

available to cane breeders constitutes an embarrassment of riches, and demands study of the most profitable mode of utilization. Simultaneously greater use must be made of biometrics as a complement to genetics in attaining best results from a breeding plan. Although very good results have been obtained in Queensland in the past with the breeding and selection methods then in use, there are already signs that better selection techniques now developed are about to improve further the productive capacity of cane varieties; varietal improvement still remains the most valuable single tool for achieving and maintaining economic stability.

Some of the disease and insect pest problems still remaining are being attacked in two ways—they are being subjected to test with remedial treatments and with commercial and experimental insecticides and, at the same time, basic studies are being conducted into life cycles, virus development and transmission, and other factors. The opportunity is also being taken to examine the feasibility, and practical value, of radio-isotope techniques in several sections of the Bureau's agricultural and milling research activities.

There are two phases of the weed control programme which require further attention. Chemical methods of weed suppression are gaining prominence at an accelerating rate. There is already an established mode of attack from the air of vine weeds and some other types associated with advanced cane; and there would be greater use of the aerial method for control of cane field weeds and grasses if more effective kills were obtained on all occasions. The other phase deals with serious weed pests of the type which should be totally eradicated to prevent a production threat to sugar lands; these include giant sensitive plant, Johnson grass and—more recently—*Sorghum miliaceum*. The first mentioned is a gazetted noxious weed and some real effort is being made to control and eradicate it; nevertheless it was allowed to overrun

This spring plant Q.71 is only 9 months old and cutting 44 tons per acre. Q.71 has a high c.c.s. and suits the southern environment.

one cane farm to such extent prior to concerted control measures being instituted that the assignment was transferred elsewhere, and there is danger of similar abandonment of land in two other cases. But the other two plants are not so declared and little can be done on private land without full support and financial outlay by the landowner. These stoloniferous grasses are demonstrating an ability to spread and thrive in a disquieting fashion on some alluvial lands in the Burdekin delta.

The reports from various Bureau divisions, which follow, outline in some detail the progress made in many fields of investigation during the year. Particularly pleasing are the advances made in unravelling the poor ratooning complex and establishing remedial measures in most cases, and in the chlorotic streak disease problem which has defied the efforts of pathologists in most sugar producing countries for many years. There is emerging a much better understanding of the disease, its nature, its symptom expression and its transmission.

The 1960 Season

The crushing and harvesting period began on June 15th and terminated on December 6th. There was ample cane available to cover available sugar quotas, even allowing for the extra eight and a half per cent acquisition over mill peaks made by the Sugar Board. There was surplus cane in many mill areas and much of it was retained as standover crop for harvesting, if required, in the following year.

The abnormally high sugar content of the crop came somewhat as a surprise. Although the seasonal conditions had favoured high c.c.s.—inasmuch as they were characterised by good early growth, more than normal sunlight, and a dry harvesting period—it was not anticipated, even after the start of crushing, that the figures would climb so high. An average c.c.s. of 15.27 per cent and a cane/sugar ratio of 6.58 are easily the best in the world, and they are the best ever achieved in Queensland. The credit must be divided in unknown proportions between a season particularly favourable to sugar synthesis and storage, the new, sweeter varieties making their impact on production figures, and improved milling practices.

The extra acquisition of sugar was due mainly to the disastrous cyclone damage in Mauritius, and the production deficiency there was made up by other Commonwealth Sugar Agreement countries. But there was another reason also; because of a U.S.A. allotment to the British West Indies some of the Mauritius shortfall which would normally have been taken up by that country came to Australia.

The very dry harvesting season, although conducive to high sugar content and to uninterrupted milling work, was not an unmixed blessing. The young plant cane—the start of the next year's crop—was seriously retarded by lack of soil moisture, and young ratoons were slow to start. Eight months of virtual drought in all sugar districts was not broken until the end-of-December rains in 1960. Such a dry season was

very favourable to the harvesting machines which operated in many districts, since pre-harvest burns were excellent—thus reducing the proportion of trash and top material—and soils were dry and not so adherent to front-end-loaded cane.

All figures relating to tonnages of cane harvested and sugar made appear in the relevant tables.

A bulk sugar terminal, with a capacity of 150,000 tons of raw sugar, was opened at Mourilyan Harbour during the 1960 season, thus completing the existing plan for bulk handling within the industry. Such terminals now exist at Mourilyan, Lucinda Point, Townsville, Mackay and Bundaberg.

Prospects for the 1961 Season

Throughout Queensland there was, for the second half of 1960 a very dry late winter, spring and early summer. This was uniform in all sections of the sugar belt. The early-summer storm pattern failed to develop effectively in most coastal areas and the first rain relief was experienced in the final week of December. By that time cane planted and ratooned in 1960 was in a poor state except in certain sections of the "wet" coast. The normal monsoon period in the early months of 1961 was far lighter than usual. The Babinda to Ingham sector had just sufficient rain to promote and maintain summer growth, but all other districts experienced sub-essential falls, resulting in periods of stress and reduced progress.

These climatic conditions did not favour early stalk development which would be conducive to sugar storage and a favourable cane/sugar ratio in the 1961 crop, but they were associated with a lower cloud incidence and a greater supply of sunlight to promote photosynthesis. The abnormality of the season made more difficult than normal the forecasting of an anticipated sugar content of cane.

In the early estimate of the crop—taken in May—the promise was for an aggregate of 8,975,000 tons of cane and 1,270,880 tons of 94 net titre sugar but it was considered at that time that the estimate was optimistic. Later, in two successive proclamations, the Sugar Board acquired individual

Ploughing out Q.63 ratoons in Bundaberg on account of leaf scald. This was part of the quarantine precautions brought into operation to control and eradicate this outbreak.

mill peaks, plus 15 per cent, but the individual mill estimates disclosed that of the State's 31 mills only one might have sufficient crop to be able to manufacture 15 per cent over its peak. The second proclamation, which raised the amount acquired from five to 15 per cent over individual mill peaks, followed the receipt by Australia of a non-quota allocation of 90,000 short tons (equivalent to 80,357 long tons) on the United States sugar market for the 1961 calendar year. It is possible—indeed highly probable—that this tonnage of sugar, when added to the aggregate mill peak, will enable the harvest of the entire Queensland crop this year.

Following the taking of the May estimate the weather position deteriorated in most districts, inasmuch as it operated against improved crop production. Dry weather persisted in most mill areas, the onset of winter was early and well-marked, and severe frosts damaged cane in varying degree in some of the central and southern localities. By the end of June, 1961, it was therefore apparent that the earlier crop estimate would not be reached.

At the time of writing this report a new survey of the crop has been completed. It has been possible to introduce some abatement due to frost damage and to continuing dry conditions in some districts. It has also been possible to calculate from the sugar content of early-cut cane what form the c.c.s. curve might take for the season. As a result of this survey the May estimate has been reduced appreciably. It is now considered that the total cane available will be 8,679,500 tons, producing 1,229,504 tons of 94 net titre sugar; that sixteen of the State's 31 mills will make sugar in excess of their peaks; and that only two of those sixteen could exceed the acquisition of 15 per cent over peak.

Mechanizing the Harvest

One of the really significant happenings during the past year has been the emergence of mechanical cane harvesting from the experimental phase. Admittedly cane has been harvested by machines for many years at Fairymead on a commercial scale, but the method had never extended throughout the industry except sporadically and on a very small, experimental scale. There is no question now but that the mechanization of cane cutting has arrived. The industry is still feeling its way and is, very wisely, employing both full-stalk harvesters and chopper-harvesters so as to assess the advantages and economics of each.

In making any brief reference to the subject there is danger of over-simplification and of creating a faulty impression. The full-stalk harvesters are fast and efficient on erect cane, while the chopper-type machines are slower but capable of handling lodged as well as erect crops. The factors which make comparison difficult are initial capital cost, output per unit period, cleanliness of the cane as delivered for crushing, elapsed time between pre-harvest burning and crushing and a number of others. In addition, some trials, with a possible far reaching effect, are being conducted at Mossman with road haulage from field to mill immediately after harvesting with a chopper-type machine.

The development of machines which will

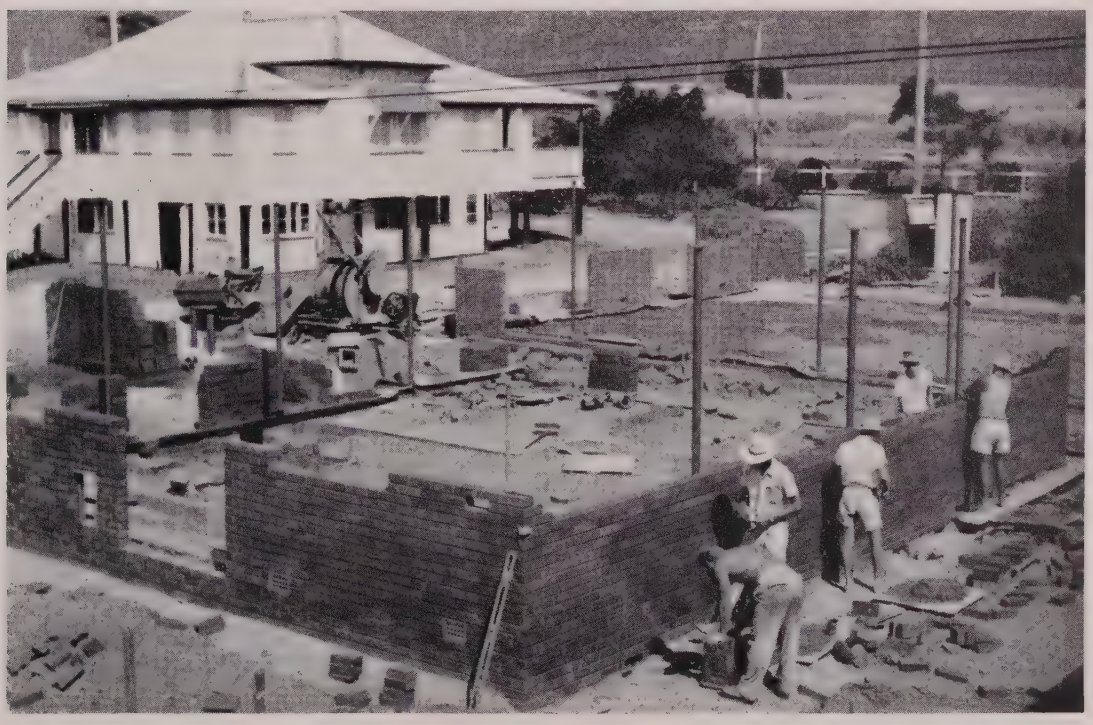
At Eight Miles Plains Pathology Farm polythene strips were used to cover the drills in a cold-weather planting. Soil covers the edges of the strips and the drill becomes a hot-house.

harvest cane will doubtless be a steady evolution, as has been the case with every other agricultural machine or implement. But it would appear that Queensland now has available a number of types which are reliable in commercial usage and which are capable of handling a very large proportion of the crop. The industry must inevitably move in the direction of increased mechanization in this phase of production—particularly if the movement of Great Britain towards the European Economic Community imposes further stresses on our industry's economic structure. It is in the industry's best interests, therefore, to collate as much data as possible on the whole subject of harvest mechanization so as to be prepared for the major decisions when they have to be made. Already there are some technical problems which have been created by mechanical harvesting—quite apart from the handling of the crop itself. These have to be investigated and clarified, and they become part of the overall mechanization study.

Nitrogenous Fertilizer

During the year the manufacturers in Australia of sulphate of ammonia applied for Tariff Board protection against imported nitrogen-bearing fertilizers and were successful in having an increased tariff imposed as a temporary measure. Following the hearing in connection with this emergency enquiry there was a full Tariff Board hearing dealing with the matter of protection for the nitrogen fertilizer industry. The result of the temporary protection was that the fertilizer distributors then increased sulphate of ammonia prices in Australia by £3 per ton and urea by £3 15 0 per ton.

Just after the end of the 1960-61 financial year the largest fertilizer company in Queensland announced the taking of immediate steps to



In the early stages of the new building being erected at Meringa Experiment Station.

market aqua ammonia in Queensland; this is a new and major development in fertilizer technology in Australia. Arrangements are apparently complete for the commencement of marketing in the Mackay area, and construction has begun on a 2,500 ton capacity storage tank at the Mackay Harbour. The fertilizer company is, simultaneously, attending to such matters as providing drum lots of aqua ammonia as well as bulk supplies, and arranging for the marketing of application equipment.

The Bureau played a small part in this development in co-operating with the company in establishing field trials with aqua ammonia to measure its efficiency against sulphate of ammonia. In the small number of trials conducted no significant differences were detected.

This pleasing development—pleasing because a cheaper source of nitrogen becomes available—provides a well-needed stimulant following the increases in nitrogen prices imposed by the Australian manufacturers. Queensland sugar-cane growers have agitated for a long period for less costly sources of fertilizer and for more concentrated types. Urea was one answer to the request giving, as it did, higher nitrogen content with lower unit cost. Although aqueous ammonia is no more concentrated than sulphate of ammonia, in regard to nitrogen content, it is cheaper; and, once the initial teething troubles associated with handling and applying a new product are overcome, aqueous ammonia should find an important place in the industry.

Building at Meringa

The Bureau began its Meringa operations in 1917 and, until 1934, it was a centre only for entomological investigations. Since then it has become the Bureau's most important country centre and, since the last war particularly, the staff has outgrown the available space. Furthermore, modern laboratory and technological facilities are not available there. On the recommendation of the Director the Board approved the erection of a central building on that Station, the structure to form the first unit of what is planned ultimately to be a composite block embracing all departments. This began in 1961

There are many acres of spare land on the Pathology Farm and they have been planted with Pinus Elliotti.

and will be completed by the end of the calendar year. It is anticipated that the building will not reach its final form for several years, the existing wooden buildings being replaced progressively as they become too costly to maintain. Simultaneously with the building development, planning and provision will be necessary for the several ancillary annexes which form integral parts of the plant breeding and genetics division.

Credits

In varying the layout of this report, in an endeavour to make it more attractive and informative, mention has been made, at the head of each section, of the personnel principally responsible for the investigations. However, there are many other members of the field and laboratory staffs who have played an important part in the work and I wish to acknowledge their activities. The pathologists, entomologists, agronomists and chemists frequently depend on the advisory and extension men to lay down, inspect and harvest their field experiments and to make the necessary observations thereon. This form of directed team work is not only responsible for the progress made in many investigations, but makes the extension staff peculiarly fitted to pass on any worthwhile findings to the cane-growing community.

PUBLICATIONS BY BUREAU STAFF

In the Proceedings of the Q.S.S.C.T.

Barrie, A. G.	Variations in Yield in North Queensland.
Barrie, A. G.	Notes on New Cowpea Varieties.
Buzacott, J. H.	Cane Breeding Plans for the Southern Districts.
Egan, B. T. and Whitaker, G. H.	Copper Deficiency in the Mossman Area and its Control.
Hughes, C. G.	Leaf Scald Disease in Queensland.
Leverington, K. C.	Soil Salinity in Some Queensland Soils.
Moller, R. B.	Soldier Fly Experiments.
Vallance, L. G.	Sugar Per Acre.

Technical Communication.

Skinner, J. C.	Competition between Varieties.

A.N.Z.A.A.S. Conference.

Buzacott, J. H. and Skinner, J. C.	Sugar Cane Breeding.

Proceedings of the Genetics Society of Australia.

Skinner, J. C.	Estimation of Genetic Variance caused by Competition between Varieties.

International Sugar Journal.

Hughes, C. G.	Striate Mosaic—A New Disease of Sugar Cane.

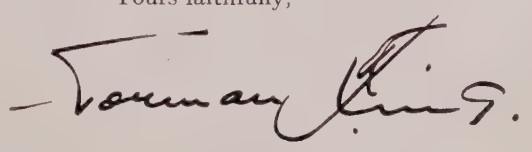
Sugar y Azucar.

Sturgess, O. W.	Investigations into Chlorotic Streak Disease.

The Laboratory Manual for Queensland Sugar Mills was revised and partly re-written, and a Fourth Edition published.

Four issues of the Cane Growers' Quarterly Bulletin were distributed and two issues of the News Letter. Circulated also to the twenty-seven member mills were the Mutual Control Synopsis and the Supplement to the Plant Data Record. Ten papers were contributed to the Proceedings of the Cane Pest and Disease Control Boards' Conference.

Yours faithfully,



Director.

Appendix I

C.C.S. Formula

$$\text{C.c.s. in cane} = \text{Pol in cane} - \frac{\text{Soluble impurities in cane}}{2}$$

In practice, per cent c.c.s. is calculated by the empirical formula—

$$\text{C.c.s.} = \frac{3P}{2}\left(1 - \frac{5 + F}{100}\right) - \frac{B}{2}\left(1 - \frac{3 + F}{100}\right)$$

where—

P = pol per cent first expressed juice.
B = brix per cent first expressed juice.
F = fibre per cent cane.

Sugar Values, 1960 Season

The final prices for the 1960 season's sugar have been declared as follows—

	No. 1 Pool			No. 2 Pool			
	Home Consumption	Surplus	Total	Excess 3rd Quota	Excess 4th Quota	Unassigned 5th Quota	Total
Tons	523,200	691,979	1,215,179	103,669	316	21	1,319,185
Per cent	43 0554	56.9446	100	—	—	—	—
Price	£62 10 6	£41 6 0	£50 8 9	£30 18 6	10 0	10 0	£48 17 9

In addition the value for New South Wales production was—

	Home Consumption	Surplus	Total
Tons	36,372	26,557	62,929
Per cent	57.7990	42.2010	100
Price	£62 10 6	£41 6 0	£53 11 4

Table A

Summary of production and consumption figures and sugar values for ten years

Year	Total Sugar Production at 94 n.t.*	Total Sugar Exported at 94 n.t.	Average Australian Price	Average Export Price	Average Price No. 1 Pool Sugar	Average Price All Sugar	Total Value
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	£
1951	704,043	154,486	33 14 0	36 15 6	34 7 4	34 7 6	24,200,837
1952	934,226	471,008	44 3 0	41 2 0	42 14 2	42 12 3	39,809,505
1953	1,220,025	730,566	47 18 6	38 13 9	43 8 3	42 7 11	51,721,505
1954	1,300,842	784,449	47 1 0	37 8 0	42 9 11	41 4 7	53,635,071
1955	1,135,341	624,527	46 18 0	38 11 6	42 14 2	42 6 5	48,047,797
1956	1,171,518	673,751	53 11 6	41 6 5	47 1 9	46 10 6	54,506,608
1957	1,255,911	740,555	54 3 0	45 16 8	49 17 2	49 5 0	61,849,607
1958	1,353,228	832,181	54 15 0	39 8 2	47 4 5	45 6 3	61,321,200
1959	1,216,549	680,057	56 8 6	40 6 2	47 9 7	47 8 4	57,684,795
1960	1,319,185	795,985	62 10 6	39 18 8	50 8 9	48 17 9	64,497,942

*Excluding Local Sales.

Table I

Sugar Cane Harvested, 1960—Estimated, 1961

Domestic Tonnages	Actual Tonnages		Mills	Estimated, 1961 (May estimate)
	Accepted	Condemned		
231,124	231,124	—	Mossman	227,000
324,176	324,176	40	Hambledon	310,000
342,072	342,072	120	Mulgrave	320,000
348,637	348,637	—	Babinda	381,500
279,063	279,063	37	Goondi	292,000
251,806	251,806	10	Mourilyan	263,000
362,440	362,440	—	South Johnstone	385,000
353,042	353,042	12	Tully	376,186
627,973	628,212	73	Victoria	600,000
356,742	356,742	41	Macknade	373,000
3,477,075	3,477,314	333		3,527,686
190,391	190,152	10	Invicta	181,000
321,228	321,228	—	Pioneer	330,000
342,628	342,628	—	Kalamia	339,000
412,229	412,229	22	Inkerman	462,000
1,266,476	1,266,237	32		1,312,000
318,526	318,526	31	Proserpine	300,000
309,330	309,332	50	Farleigh	320,000
302,374	302,369	15	Racecourse	320,000
304,806	304,918	41	Pleystowe	320,000
289,358	289,249	—	Marian	304,000
167,953	167,953	22	Cattle Creek	178,000
176,273	176,273	—	North Eton	220,000
301,437	301,437	—	Plane Creek	304,000
2,170,057	2,170,057	159		2,266,000
284,107	284,107	—	Fairymead	280,000
140,984	140,984	—	Qunaba	140,000
270,704	270,704	27	Millaquin	288,000
296,890	296,890	25	Bingera	330,000
125,402	125,402	103	Gin Gin	120,000
304,913	304,913	49	Isis	333,000
148,755	148,755	9	Maryborough	174,000
153,686	153,686	—	Moreton	154,000
46,377	46,377	—	Rocky point	50,000
1,771,818	1,771,818	213		1,869,000
8,685,426	8,685,426	737		8,974,686

Table II

Sugar Production (94 Net Titre), 1955-1960

Districts	1955	1956	1957	1958	1959	1960
North of Townsville	413,853	406,172	516,345	540,476	485,660	525,405
South of Townsville	721,822	765,698	739,926	813,067	731,360	794,228
Totals*	1,135,675	1,171,870	1,256,271	1,353,543	1,217,020	1,319,633

*Local Sales included.

Table III
Classes of Cane Harvested, 1960

Districts	Plant Cane		Ratoons		Standover		Total Acres
	Acres	%	Acres	%	Acres	%	
Northern ..	39,344	30.9	85,728	67.3	2,248	1.8	127,320
Burdekin ..	17,896	52.3	14,772	43.1	1,584	4.6	34,252
Mackay	40,366	39.3	59,802	58.3	2,446	2.4	102,614
Southern ..	15,666	24.9	23,930	37.9	23,464	37.2	63,060
Whole State	113,272	34.6	184,232	56.3	29,742	9.1	327,246

Table IV
Total and Average Yields by Districts, 1960

Districts	Tons of Cane	Tons Cane per Acre	Tons 94 n.t. Sugar per Acre
Mossman-Ingham	3,477,075	27.31	4.13
Lower Burdekin	1,266,476	36.98	5.77
Proserpine	318,526	20.83	3.21
Mackay	1,851,531	21.20	3.35
Bundaberg-Gin Gin	1,118,087	28.40	4.11
Childers-Maryborough	453,668	27.87	3.98
Nambour-Beenleigh	200,063	27.01	3.84
Whole State	8,685,426	26.54	4.03

Table V
Acres Cultivated and Harvested, Yields of Cane and Sugar, Acre Yields and Quality of Cane, 1951-1960

Year	Acres* Cultivated	Acres Harvested for Milling	Total Yields		Yields per Acre		Tons Cane per ton Sugar
			Cane	Sugar†	Cane	Sugar	
1951	388,348	273,371	5,005,172	704,342	18.31	2.58	7.11
1952	419,834	274,757	6,841,536	934,614	24.90	3.40	7.32
1953	466,484	332,703	8,751,063	1,220,383	26.30	3.67	7.17
1954	486,741	367,640	9,864,305	1,301,245	26.83	3.54	7.58
1955	482,145	365,252	8,616,163	1,135,675	23.59	3.11	7.59
1956	480,116	360,932	8,978,081	1,171,870	24.87	3.25	7.66
1957	485,355	364,985	8,945,617	1,256,271	24.51	3.44	7.12
1958	486,801	356,210	9,740,795	1,353,543	27.35	3.80	7.20
1959	461,885	299,732	8,427,731	1,217,020	28.12	4.06	6.92
1960	—	327,246	8,685,426	1,319,633	26.54	4.03	6.58
Averages ..	—	332,283	8,385,589	1,161,460	25.24	3.50	7.22

*Supplied by Government Statistician. †Includes Local Sales.

Table VI
***Details of Molasses Disposals for Periods 1951-1960.**

Usage	Tons of Molasses									
	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Distilleries ..	79,063	99,410	154,152	153,212	151,349	159,733	128,487	159,290	141,219	135,843
Fertilizer	34,529	47,260	75,781	69,446	70,691	60,841	68,001	66,637	41,710	42,997
Stock Feed ..	37,151	37,099	36,263	38,046	35,127	36,699	30,385	39,937	35,469	50,469
Mill Fuel	6,327	5,882	1,211	7,140	10,095	9,315	1,774	736	1,361	1,027
Ferment	2,033	2,532	3,196	2,779	2,727	2,871	2,411	2,828	2,520	2,533
Other Purposes ..	9	151	217	352	1,179	595	762	531	373	481
Wasted	235	482	1,111	1,544	1,232	341	1,778	703	494	14
Totals ..	159,347	192,816	271,931	272,519	272,400	270,395	233,598	270,662	223,146	233,364

*Supplied by Government Statistician.

Table B

Table of Mill Peaks (Tons of 94 n.t. Sugar)

Mill	1929	1939	1949	1950	1952	1953	1954	1957	1958	1959	1960	1961
Mossman	14,972	20,000	22,000	22,000	24,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000
H'bledon	31,836	36,000	39,600	39,600	41,000	44,000	44,000	47,500	47,500	47,500	47,500	47,500
Mulgrave	31,643	36,000	40,100	40,100	40,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Babinda	31,901	36,000	39,600	39,600	42,500	46,000	46,400	46,400	46,400	46,400	46,400	46,400
Goondi	27,034	29,500	32,400	32,400	34,500	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Mourilyan	23,630	27,000	29,700	29,700	31,000	34,000	34,000	34,000	34,000	34,000	34,000	34,000
Sth J'stone	30,979	36,000	39,600	39,600	42,500	47,000	47,000	49,000	49,000	49,000	49,000	49,000
Tully	30,930	38,000	42,100	42,100	45,000	47,000	47,000	50,000	50,000	50,000	50,000	50,000
Victoria	32,221	37,500	43,600	49,100	52,000	78,000	82,000	84,000	84,000	90,000	90,000	90,000
Macknade	30,952	34,000	39,900	46,500	48,500	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Invicta	11,736	16,000	18,300	19,100	20,500	30,000	30,000	30,000	27,000	27,000	27,000	28,000
Pioneer	21,391	26,000	30,100	34,000	35,500	45,000	45,000	47,000	47,000	47,000	47,000	47,000
Kalamia	26,053	31,000	35,400	35,600	38,000	48,000	48,000	49,000	49,000	49,000	49,000	49,000
Inkerman	24,207	31,000	36,800	42,000	45,000	55,000	55,000	57,500	57,500	58,700	58,700	58,700
Proserpine	16,650	23,000	26,300	33,000	35,000	43,000	43,000	45,000	45,000	45,000	45,000	45,000
Farleigh	16,993	23,000	27,600	32,400	33,500	42,000	42,000	44,000	44,000	44,000	44,000	44,000
R'course	18,066	24,000	29,000	35,200	36,500	36,500	42,000	42,000	44,000	44,000	44,000	44,000
Pleystowe	19,871	24,000	29,200	35,900	37,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
Marian	18,997	24,000	28,600	32,300	33,500	42,000	42,000	42,000	42,000	42,000	42,000	42,000
Cattle Creek	8,791	12,000	13,400	14,100	14,500	20,000	20,000	21,000	21,000	23,400	23,500	23,500
North Eton	9,319	12,000	14,500	15,900	17,500	26,000	26,000	26,000	26,000	26,000	26,000	26,500
Plane Creek	18,233	24,000	28,600	30,800	32,500	42,000	42,000	44,000	44,000	44,000	44,000	44,000
Fairymead	15,882	21,000	25,700	28,600	29,500	37,000	37,500	37,500	37,500	37,500	37,500	37,500
Qunaba	8,940	10,000	11,200	12,700	13,500	15,500	16,500	19,500	19,500	19,500	19,500	19,500
Millaquin	14,443	19,000	24,100	29,600	31,000	35,000	39,000	37,000	37,000	37,000	37,000	37,500
Bingera	17,864	23,000	27,800	31,000	31,500	37,000	37,000	39,000	39,000	39,000	39,000	39,000
Gin Gin	6,000	6,500	8,000	8,400	9,000	12,500	13,000	14,500	14,500	14,500	15,500	16,000
Isis	28,011	27,000	30,000	30,200	31,500	33,000	35,000	37,500	37,500	39,500	39,500	39,500
M'borough	3,862	7,500	9,500	9,500	17,300	14,500	20,000	20,000	20,000	20,000	20,000	21,000
Mt. Bauple	6,231	6,500	7,200	7,200	..	..	..	..	..	..	..	..
Moreton	11,586	14,000	16,000	16,000	16,500	20,000	20,000	20,000	20,000	20,000	20,000	21,000
Eagleby	280	300	..	..	..	..	..	..	..	..	..	..
Rocky Pt.	2,014	2,200	2,700	2,700	2,780	3,500	4,000	5,000	5,500	5,500	6,000	7,000
Total	611,428	737,000	848,600	916,900	963,080	1,152,500	1,170,900	1,203,900	1,207,400	1,213,000	1,214,600	1,220,100

Soil fumigation with Nemagon has been carried out on part of this block at 2.5 gal per acre. Left—Nemagon; right—control.

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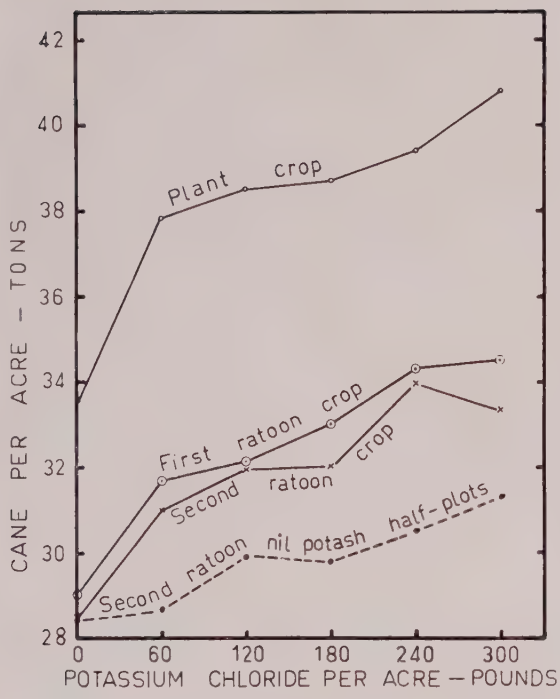
Potash Nutrition Investigations

Further work was carried out in the series of 6 x 4 randomised block potash trials. This work was commenced in 1956 and reference has been made to it in Annual Reports since that time. These trials have been designed to measure the response to six levels (nil, 60, 120, 180, 240 and 300 lb. per acre) of potassium chloride and, in addition, the effect of varying levels of replaceable soil potash is being studied. At the same time a large number of analyses to determine leaf potash is being carried out.

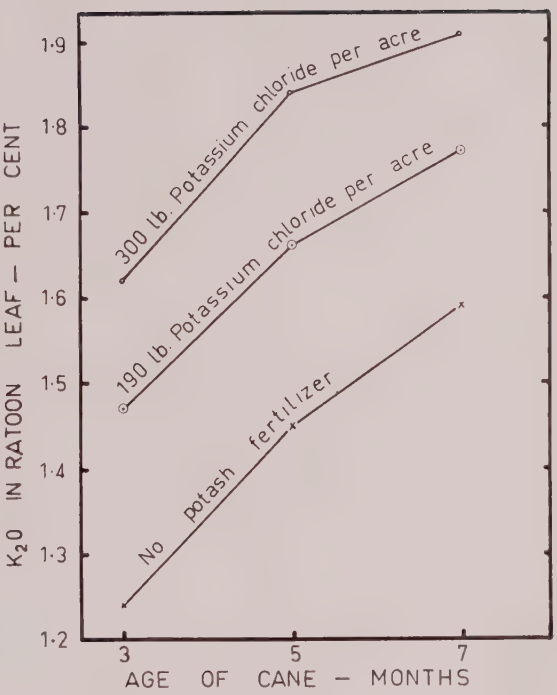
Effect of potash on tons cane per acre. The increases in yield due to potash have been somewhat less than expected, and statistically significant responses were obtained in only a limited number of cases. This lack of significance was particularly the case in the trials with plant cane, although usually the nil potash plots gave the lowest yield figures. In the ratoon crop trials the responses were greater and have reached significant levels in about half of those harvested. However, as with the plant crops, there were suggestions in practically all ratoon trials that the nil potash plots were producing the lowest yields.

At this stage it is of interest to record the results of one trial at Mackay in which both the plant and first ratoon crops had responded to potash. For the second ratoon crop all plots were split in half, one half receiving its usual treatment *i.e.* nil, 60, 120, 180, 240 or 300 lb. of potassium chloride per acre, while the other half received no potash. The accompanying graph shows the responses obtained for each of the three crops with each of the treatments. The broken line shows the lowered yield obtained from the half-plots from which potash was omitted for the second ratoon crop. The close parallelism of the two lines for this second ratoon indicated that some residual effect due to previous treatments had occurred.

Effect of potash on c.c.s. In only one trial out of a total of fourteen already harvested has there been any indication of an increase in the c.c.s. of cane as a result of the potassium chloride applications. In this particular trial statistically significant increases in c.c.s. were obtained from all plots which received 120 lb. potassium chloride or more per acre. This occurred in the plant cane and in the first and second ratoon crops. These increases ranged from 0.5 to 1.5 units of c.c.s. and were in the order of increasing potash applications. It is important to note that both soil and leaf analyses indicated that this soil was extremely deficient in potash and increases of the order of



A potash trial at Mackay showing the increases in yield of cane due to increasing applications of potash. Of interest are the yields (shown by broken line) obtained in the half plots which received no potash in the ratoon crop.



Showing the sharp increase in leaf potash that occurred with age in all the ratoon cane trials (no such consistent trend occurred in the plant cane).

15 tons of cane per acre were obtained from potash applications in the first ratoon crop.

The results which have been obtained to date from these trials would indicate that only in cases of extreme potash deficiency does any increase occur in c.c.s. due to potash application.

Seasonal variation in soil potassium. In each of these trials, one plot receiving no potash application has been sampled monthly and analysed for replaceable potash in order to determine the seasonal variation. It has been found that this variation is considerable, but it conforms in general to a pattern which is related to seasonal climatic conditions. The level of replaceable potash reaches a maximum in early or mid summer each year and then falls during the wet season which usually extends from January to March. The level is reasonably stable from May to August after which a rise commences in the spring months.

These trends are illustrated in the accompanying graphs which show the monthly exchangeable K_2O determinations for four major soil types, over a period of several years. As will be seen the noticeable features are the general fall at the beginning of the year and the tendency to rise at the end.

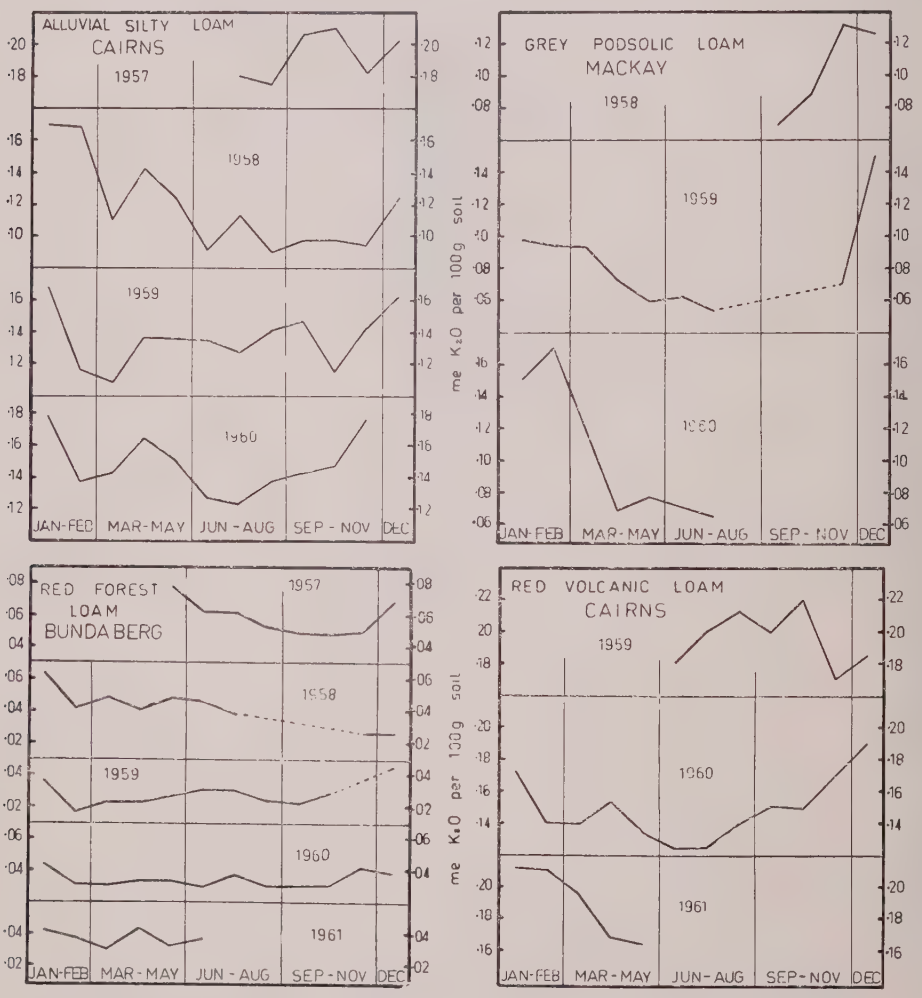
These results are also in accordance with several earlier trials which were carried out between 1939 and 1943, and the recorded information emphasises the importance of collecting soil samples for fertilizer recommendations at a standardized time of the year. Any attempted correlation of soil analyses with fertilizer trial responses must have due regard to this factor also.

In addition to the variation in soil potash which occurs during the growth of the crop there is, in most instances, a considerable rise in potash availability during the six to nine month fallow

period prior to planting and this factor probably accounts for the small number of significant responses which were obtained in the plant crops of these trials.

Leaf analysis. Samples of the third leaf were collected from every plot of each of the plant cane trials at the ages of five and seven months and each ratoon trial at the ages of three, five and seven months. In all trials there was an increase in leaf potassium with increasing applications of potash fertilizer but the magnitude of these increases was not indicative of the growth and yield response.

In all ratoon crops the potassium content of the leaves consistently increased with age of the plants. This is shown clearly in the accompanying graph where the mean potash leaf levels are plotted for ratoon cane at the age of three, five and seven months, for three levels of potash fertilizer application. Although this trend occurred



The monthly variation in exchangeable K_2O for four major soil types over a period of several years.

in some of the plant crops, in others the trend was in the reverse direction, *i.e.* there was a tendency for less potash to be present in the third leaf at seven months than at five months.

Analytical Work, Brisbane Laboratory

In the laboratory in Brisbane 2325 samples were received for analysis from all country centres except Mackay. There was a slight increase in the number of fertilizer recommendations made compared with the previous year and, in addition, more than 900 soils from experimental plots were analysed. Thirty-four per cent of the soils analysed for fertilizer advisory purposes were found to contain adequate amounts of both phosphate and potash while 19 per cent were found to be very deficient in both of these nurtients. In order that consideration of localized conditions can be taken into better account when making fertilizer recommendations the results of the analyses of soils from the Mossman to Babinda areas are now forwarded to Meringa and, at that centre, the recommendations are made for individual growers.

The dry weather has possibly been responsible for a renewed interest by farmers in irrigation water quality, and 72 samples were tested during the year.

It is an unfortunate feature of many of the waters from the Giru district that they contain high levels of soluble salts and some free alkali. Therefore several trials involving applications of lime and gypsum to the soil are now being initiated in an attempt to find a method by which damage

In this irrigation channel the area on the left was sprayed with dalapon which controlled the grass only and did not check the broad-leafed plants. A combined dalapon plus 2,4-D spray gives satisfactory results under these conditions.

Fruit of African Horned Cucumber in field after harvesting. This provides the seed for next year's infestation.

to the plants and soils can be prevented if irrigated by these poor quality waters.

Some attention has been paid to the availability of phosphate in fertilizers containing large proportions of dicalcium phosphate which is not water soluble but is soluble in ammonium citrate. This type of fertilizer is now becoming available in appreciable quantities, and it is necessary to test its relative availability to the cane plant under Queensland conditions in comparison with the water soluble phosphate of mixtures containing superphosphate. A laboratory experiment to investigate this has been commenced and, in addition, six field trials to study the problem are being laid out on phosphate deficient soils.

Magnesium Trials

On a number of soil types in the Mossman to Babinda area a fine orange freckling of the leaves similar to that produced by growing plants in magnesium deficient solutions has been noted on the varieties Pindar and Q.57. Leaves from a number of healthy and "freckled" fields were analysed for magnesium and the following results were obtained.

	No. of Samples	Range % MgO	Average % MgO
Healthy leaves	9	0·153-0·301	0·213
"Orange" freckle leaves	11	0·057-0·111	0·099

Sixteen strip trials, to which magnesium carbonate was applied at the rate of 500lb. per acre, were laid out in October, 1960; but in only one case was the orange freckling eliminated. In this instance the leaf magnesium rose from 0.109 per cent MgO to 0.190 per cent MgO but, as there has been no general response, the freckling cannot yet be definitely attributed to magnesium deficiency.

Several quantitative magnesium trials have now been set out for further study.

Analytical Work Mackay Laboratory

A total of 425 samples was received for analysis and comprised the following:—

Soil samples—	Farmers' samples	228
	Trial ,,	135
	Special ,,	40
Water Samples		22

The farmers' samples requiring fertilizer recommendations showed a decrease of approximately 100 from the number analysed the previous year and most probably a lessening of interest in this service is indicated now that restrictions to peaks have been enforced. The phosphate and potash of these samples were as follows:—

Phosphate \ Potash	Low	Fair	Good
Low	57 (25%)	20 (8.8%)	30 (13.2%)
Fair	11 (4.8%)	12 (5.3%)	9 (3.9%)
Good	29 (12.7%)	21 (9.2%)	39 (17.1%)

Miscellaneous analytical work included checking the reproducibility of the B.S.E.S. method for determination of available phosphate, and a semi-micro method for nitrogen estimations.

A rapid method for extracting available potassium from soils with neutral normal ammonium acetate was compared with the present B.S.E.S. method. The results indicated that, on the limited number of samples tested, similar amounts of potash were extracted with the rapid method as with the .02N hydrochloric acid leaching method now in use. As this leaching is often prolonged when applied to some alkali soils from the Mackay district, due to the dispersion of the clay, the ammonium acetate extraction may prove to be valuable with certain soil types.

Weeds and Weed Control

General—The increasing use of mechanical harvesters, and consequent inclusion of weed material in the cane crop harvested, has placed considerable emphasis on the necessity to control weeds in mature cane. The main weeds concerned are *Ageratum spp.* and *Crotalaria spp.* Both of these grow mostly late in the season after the cane is out of hand. Vines are also a problem at harvesting but are easily controlled, except in the case of *Passiflora foetida*, by aerial spraying with 2,4-D. Some 5,000 acres of cane were successfully sprayed by aircraft for the control of vines in the Ingham district alone.

Trials for the control of weeds growing beneath the canopy, such as ageratum, by aircraft spraying shortly before harvest were attempted in several areas during the season. The treatments left much to be desired and were, in the main, unsatisfactory. Variable control of ageratum was obtained and it was considered that a single cultivation with an inter-row tractor would have done much more. This cultivation has been generally neglected since the disappearance of the horse-drawn scarifier.

With weedicides three avenues of control are presented, pre-emergent control, young growth control, mature growth control. The application of control measures in the pre-emergent and young growth stages has the advantage that the plants are then more susceptible to hormone type weedicides and that the weed competition is controlled in the earlier stages of the crop. A number of farmers have used 2,4-D regularly on early weed growth for the last ten years and the successes have outnumbered the failures.

The foliage desiccant "diquat" has considerable potential value in ageratum control. In field trials this material showed itself to be readily translocated in ageratum and at half a pound per acre gave satisfactory control of the weed.

The use of arsenical preparations for killing weeds around roads and headlands expanded considerably. This work was carried out in many areas, usually at the commencement of the harvest season, to make the way clear for harvesting activities.

Giant Sensitive Plant—A fresh outbreak of giant sensitive plant, *Mimosa invisa* was reported in the Macknade area. This caused some concern as it was situated in the centre of the main growing area of the district. It was associated with a planting of *Centrosema pubescens* made from seed purchased in 1960. Regular inspections and sprayings of all known sites continued.

A series of trials using 2,4-D, simazine, borascu, polyborchlorate, diuron, vorox 80, vorox granular and methyl bromide fumigation, were set out in the Innisfail district in an effort to find a material which would provide a lengthy soil sterilization and thus control germination of giant sensitive plants in infested areas outside cultivations. The most satisfactory material proved to be 2,4-D at two pounds per 100 square feet. This gave consistent results and freedom from all plant growth for up to seven months. It is considered that with the weedicide application being made in spring just prior to germination of the weed, control of the pest for one growing season will be obtained. Trials to confirm or disprove this will be set out in the 1961 season. At current prices the cost of treatment using 2,4-D is approximately twelve shillings and sixpence per 100 square feet.

Pre-emergence Trials—A replicated trial using monuron, diuron, simazine, atrazine, fenetrol S

and 2, 4-D was set out on the Meringa station in February. The weedicides were applied after ploughing and discing to a fine tilth.

The application rates in terms of lb. active ingredient in 60 gallons of water per acre were as follows:—

monuron 80 per cent	3.2 lb.
diuron 80 per cent	3.2 lb.
atrazine 50 per cent	2.0 lb.
simazine 50 per cent	4.0 lb.
fenetrol S 18 per cent W/V	4.0 lb.
2, 4-D 80 per cent	3.2 lb.

Initial weed seed germination was commencing in all plots at the time of treatment but the seedlings died off within two weeks in all cases though some weeds which had germinated from the greater soil depths survived.

Four weeks after treatment the percentage control achieved was: monuron 96 per cent, diuron 90 per cent, atrazine 94 per cent, simazine 94 per cent, fenetrol S 100 per cent and 2, 4-D 60 per cent. In the 2, 4-D treatment only broad-leafed weeds had appeared. There were no grasses. Later, the simazine and atrazine treatments deteriorated rapidly whilst control in monuron and diuron applications broke down more slowly. The fenetrol S plots remained in excellent condition, whilst the 2, 4-D treated areas became a mass of weeds.

After twenty weeks atrazine had given control of all weeds except crowsfoot (*Eleusine indica*) and guinea grass (*Panicum maximum*). The latter was the most prolific. With simazine, the guinea grass

A weedicide trial at Meringa. The foreground plot was sprayed with Fenetrol S in March, 1961, and photographed in June. Other plots sprayed with other chemicals show varying grades of control.

Control of weeds and grass in a cross drain by diuron at the rate of 20 lb per acre.

was controlled but crowsfoot became prominent. The monuron plots had a population of crowsfoot and barnyard grass (*Echinochloa crus-galli*) but no broad-leafed weeds. The diuron treatments contained less grasses but more broad-leafed species. The fenetrol S treatments were still in excellent condition. Only a very few plants of wild passion fruit (*Passiflora foetida*) and couch grass (*Cynodon dactylon*) remained in these plots. Fresh germinations of seedlings were evident in all but the fenetrol S plots.

A duplicate trial was set out and this confirmed the previous results; lower treatments with fenetrol S at nine pints per acre, i.e. two pounds of active ingredient, still gave excellent control.

A series of pre-emergence weedicide trials was set out in the Mackay, Lower Burdekin and Bundaberg districts using monuron and diuron at 2, 3, 4, 5 and 6 pounds per acre. These were to investigate the possibility of using these materials to control the heavy weed growth which usually occurs at the beginning of the wet season when the cane is too far advanced and fields too wet for the use of normal cultivating implements. At Mackay good control was obtained with dosage rates heavier than three pounds per acre, with diuron the more efficient. Breakdown of control was noticed in all treatments resulting from soil movement due to rain. In the Lower Burdekin disappointing results were obtained in ratoon stubble cane. At Bundaberg the materials gave unsatisfactory results under irrigated conditions.

Post-emergent Trials—A replicated set of post-emergent treatments was also set out at Meringa. The materials used were monuron, atrazine, vorox 80, dalapon, weedazol total, 2,4-D + P.C.P. and fenetrol S. After cultivation of the area, the weeds were allowed to grow unchecked for three weeks before the treatments were applied.

The weeds present at time of treatment were crowsfoot, couch, guinea and summer grasses (*Digitaria adscendens*), pig weed (*Portulaca oleracea*), wild gooseberry (*Physalis minima*), billygoat weed (*Ageratum houstonianum*), and *Crotalaria spp.*

All the weedicides were applied at the rate of four pounds of the commercial product per acre except in the case of fenetrol S where the dosages were 18 pints, 9 pints and 4.5 pints per acre. The volume of spray applied in each case was at the rate of 100 gallons per acre.

The results showed that atrazine and monuron could be used effectively for post-emergence general weed control at the rates used but that the dosages would need to be heavier if the weeds were well established. Fenetrol S was valueless for post-emergent control purposes. With the remaining materials control was unsatisfactory at the dosage rates used, but could possibly be successful at higher rates.

Weeds in Drains—In the Lower Burdekin district, diruon at the rate of 20 lb. per acre gave very good results in weed control in irrigation channels and is now used commercially by some farmers with satisfaction. In the Bundaberg area aquatic weed control with dalapon and varying ingredients such as weedazol, TCA and PCP is now standard practice. For a complete control the mixture used is four pounds each of dalapon and weedazol per acre. Light to medium infestations respond well to half these quantities.

Both dalapon and arsenical preparations are

now used to a considerable extent in North Queensland to clear drainage channels.

Thick Head—Thick head (*Crassocephalum crepidioides*) is becoming a weed pest in cane in the Nambour district. Trials against thick head using a number of 2,4-D and 2,4,5-T preparations as well as amizol 90, and C105 were unsuccessful. Sodium chlorate, PCP and arsenical preparations generally successfully killed the weed, but also caused damage to the cane, and are somewhat dangerous to use.

Wild Passion Fruit—Further investigations were carried out in the Ingham district into the control of *Passiflora foetida*. Materials used were CMU, diquat, amitrol and low volatility esters of 2,4-D and 2,4,5-T. CMU, used as a foliage spray at one ounce per gallon of water, gave an 80 per cent kill of vigorous vines. The other materials, particularly diquat, resulted in spectacular above-ground death but failed to prevent regrowth from the roots.

Oat Grass—This annual grass, *Themeda quadrivalvis*, an introduction from India, is becoming a pest on headlands, roadsides and in growing cane in parts of the Mackay district. A trial was set out late in the season using dalapon, weedazol total, vorox 80 and TCA in the Mackay area. Only TCA at 25 pounds per acre was promising as a treatment for mature grass. Further investigations will be carried out with young grass next summer.

Turnsole—Further investigations of possible control of turnsole (*Heliotropium amplexicaule*)

The logarithmic sprayer, built on an Allen motor scythe, is a valuable tool in establishing weedicide trials where many rates of application are desired.

Johnson grass is such a serious pest that the Bureau is aiming at complete eradication on cane farms. Here the seedling population is heavy on an alluvial-soil Burdekin farm.

were made in the Childers area. The most promising results so far obtained were with a mixture of weedazol and ammonium thiocyanate. Good results were also given by weedazol plus monuron, and trimex plus monuron. It yet remains to be seen whether the root system is inactivated as well as the top growth.

Wild Sorghum—A trial to control wild sorghum (*Sorghum verticilliflorum*) at Childers was conducted using dalapon, weedazol and a mixture of both. Dalapon alone was the most effective treatment when applied in three split applications, each of five pounds per acre. This killed the top growth of mature as well as young plants. The plants require a thorough wetting for best results.

Johnson Grass—Investigation of control of Johnson grass (*Sorghum halepense*) continued in the lower Burdekin. Spraying of mature grass with dalapon or dalapon plus TCA gave a good kill of the top growth but there was regeneration from the rhizomes.

Much of the Johnson grass regeneration this season in the cane crop was shown to be due to seedling growth and not mostly from rhizomes as previously was thought to be the case.

Sorghum Miliaceum—A species of grass closely resembling Johnson grass, but of a more vigorous type with more robust rhizomes was identified on two farms in the Lower Burdekin area. This is the first record of its presence in Australia.

Nematodes

Fumigation Trials—The work in connection with nematode investigations is continued.

The plant crop of Pindar in a fumigation trial at Bartle Frere was harvested. The treatments used were broadcast and row applications of nemagon at 2 and 2.5 gallons per acre. At harvest there was no significant difference in cane tonnage between the row and broadcast treatments at the higher rate. The row treatment with 2.5 gallons per acre was significantly superior to the broadcast one at 2 gallons per acre. Both row and broadcast treatments at 2.5 gallons per acre were significantly superior to the untreated plots, and resulted in an increment of approximately seven tons of cane per acre above the untreated cane. The nematode species infesting the soil were *Pratylenchus brachyurus, Helicotylenchus nannus, Xiphinema pratensis* and *Meloidogyne javanica.*

In another trial in the Babinda area three soil fumigants, each at two dosage levels, were used in a replicated experiment in plant Q.57. The yields ranged from 40 to 48 tons cane per acre, and analysis of the figures showed that both levels of nemagon were significantly superior to the DD and EDB treatments at 8 gallons per acre and to the controls.

In the Mackay district a first ratoon crop was harvested from a trial which had been fumigated at planting in 1958. Mean weights of sample rows from plots of each treatment were as follows:—

Treatment	Tons Cane per Acre	C.c.s.
DD 20 g.p.a.	30.19	17.38
EDB 20 g.p.a.	29.87	17.26
Control untreated	20.55	17.32

In this trial the results of fumigation in the plant crop have considerably influenced the behaviour of the ratoon cane without further treatment to the extent of an increment of approximately

nine tons of cane per acre in both treatments above the results from the untreated cane.

A further fumigation trial in the same district was harvested. This consisted of a randomized block of fourteen treatments. The treatments consisted of varying dosage rates of nemagon and DD with the necessary untreated control plots. Pre-harvest damage by rats resulted in considerable unevenness in harvest figures in some plots.

The yields in the various nemagon plots varied between 29 and 33 tons per acre, in the DD plots between 27 and 31 tons per acre, and, in the untreated it was 26. In general, the nemagon treatments were significantly better than the DD plots and the control.

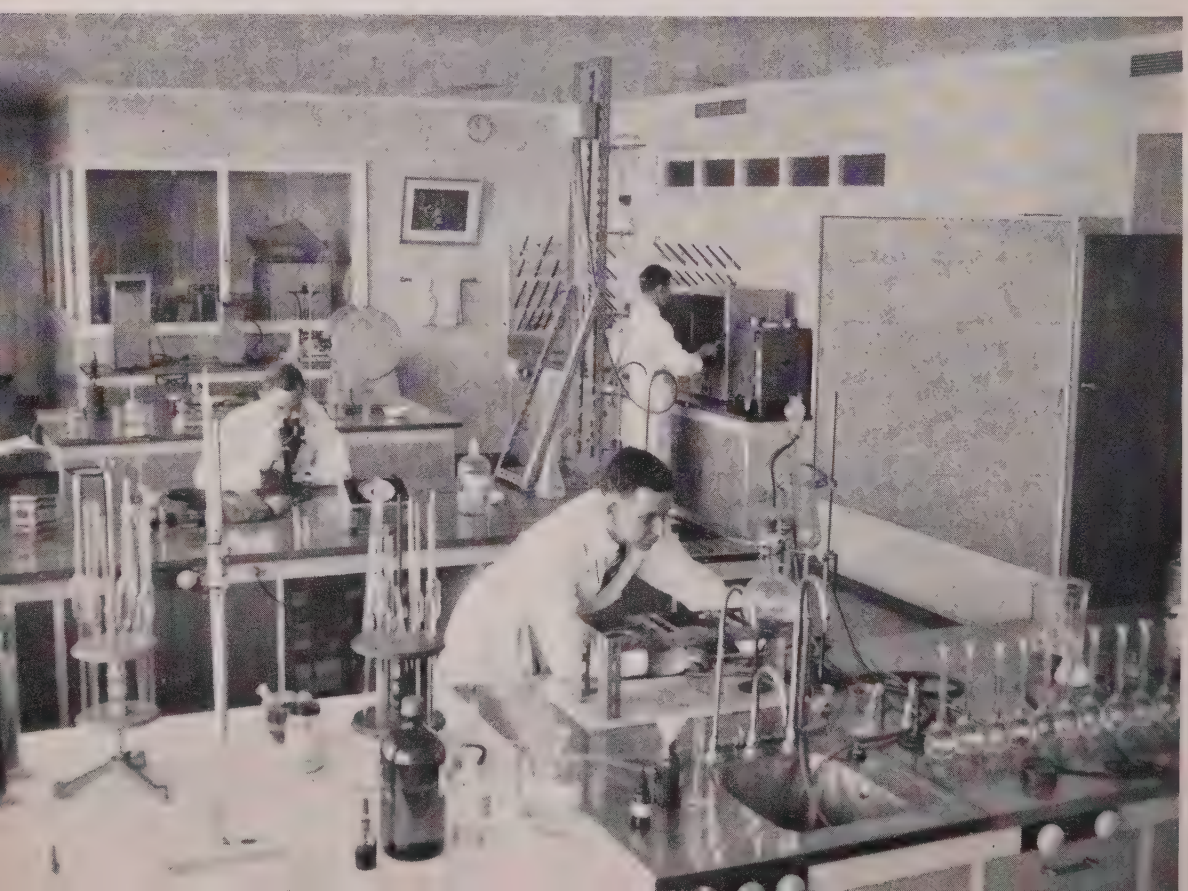
The nematode species concerned in this trial were *Tylenchorhynchus martini*, *Pratylenchus brachyurus*, *Trichodorus minor* and *Helicotylenchus nannus*.

Varietal Resistance—In order to explore the possibility of the existence in cane of resistance to nematode damage in some varieties a trial was set out in the Bundaberg area in which the most important cane varieties grown in the district were planted in a replicated randomized plot design. Half of each plot of each variety was fumigated with nemagon at 2.25 gallons per acre and the other half of each plot was left untreated.

The trial was partially spoiled due to uneven irrigation and a row of control plots received water when an adjacent commercial planting was being irrigated. The varieties Q.50, Q.68, Q.70 and Q.61 showed decreasing tolerance to nematode attack in that order. There was little difference between the fumigated and non-fumigated halves of the plots in those cases. In the case of Q.63, Co.290, C.P. 29-116, Q.58, Vesta, Q.71, N.Co.310 and Q.47, however, there was much greater cane growth in the fumigated parts of the plots compared with the non-fumigated sections. Portion of the treated plots was given a further treatment with nemagon at the same rate but no added response was noticed.

This trial is being repeated at Bundaberg and similar trials have been set out in other districts using the cane varieties grown in those places.

In the Bureau's Brisbane soils laboratory. Here are conducted all soil analyses, examination for nematodes, and testing of water samples.



Early observations in the trial at Mackay indicate that Q.50, as at Bundaberg, appears to be the most tolerant whilst Q.68 and N.Co.310 seem to be the least tolerant. Harvest results are being awaited with interest.

In the present Bundaberg trial site the nematode species present are *Trichodorus minor, Pratylenchus brachyurus, Tylenchorhynchus martini* and *Meloidogyne sp.* The number of nematodes per 500 grams of soil in the untreated soil averaged 1140. The average count in the treated plots at the same time and five months from treatment was 180.

In the Mackay trial the species present are *Helicotylenchus nannus, Trichodorus minor, Xiphinema pratensis, Pratylenchus zeae, Tylenchorhynchus martini* and *Criconemoides sp.* The population of the soil before treatment was 9700 parasitic nematodes per 500 grams of soil.

General—In a skirmish trial on a poor growth area on Fairymead Plantation at Bundaberg involving fertilizer, insecticidal and nematicidal treatments, nemagon at 2.25 gallons per acre was the only treatment to cause a favourable response and at harvest the nemagon treated plots returned 11 tons of cane more per acre than the untreated area. The nematode species involved in this trial was *Meloidogyne javanica.*

Nematode damage associated with near drought conditions was observed in a number of districts during the season. There seems little doubt that varietal tolerance to nematodes would be a very desirable characteristic for the lower rainfall areas of the sugar belt.

Soil samples from clean fallow fields adjacent to land under crop have been found, in general, to contain relatively few nematodes whereas the land under crop has a high population. It also seems that the presence of individual species of nematodes is of greater importance than total soil population of parasitic types.

A total of 178 soil samples were examined for nematodes in connection with trials and other investigations.

Soil Conservation

The demand for advice on soil conservation continued as in previous years but very few farmers on the whole are really interested.

During the year 110 acres were contoured on fifteen farms in the Childers, Gin Gin and Maryborough areas.

Deterioration of Burnt Cane

At the request of the Queensland Cane Growers' Council a series of trials was carried out to investigate the comparative changes in weight, c.c.s. and sugar yield between cane left standing and cut down after burning. Twelve trials were conducted, comprising an early season, mid-season and late season trial in each of the four major cane growing areas, North, Burdekin, Central and South.

The differences in time and location of trials was arranged so that different climatic and seasonal factors occurring in different places during the harvest season might be covered. Each individual trial consisted of 0.5 acres of cane which was divided into ten plots for sampling purposes. In each case the trial was burnt one evening and sampling was carried out daily thereafter for five days. On the first day, in addition to samples required for the first day's weighings and analyses, all cane required for the cut cane treatment for each day's sampling was cut and bundled and left on the ground. Samples from cut and standing cane were gathered on each subsequent day.

Over the whole series of trials there was no difference in weight behaviour between the two treatments at Bundaberg and Mackay; both classes of cane lost weight. At Meringa and the Lower Burdekin the standing cane gained weight whilst the cut cane lost weight as at Bundaberg and Mackay. However, this weight gain of the standing cane is considered to be due to experimental error.

In all four districts, the standing cane lost in c.c.s. percentage whilst the cut cane gained.

In all districts the cut cane lost in sugar yield. The gain in yield of the standing cane at Meringa and the Lower Burdekin is considered to be due to the same sampling error which is thought to have occurred in connection with weight performance.

A Bureau agronomist and a cane grower discuss the problem before establishing contour lines for soil conservation on the property.

Reduction of Extraneous Matter at Harvest

With the advent of mechanical harvesting, the reduced selectivity of harvesters as compared with hand labour tends to increase the percentage of extraneous matter sent to the mill with the cane. This is brought about by the inclusion of a percentage of cane tops, particularly in the case of tangled crops, and by weeds.

With the object of attempting to reduce the amount of tops left after the burn a series of trials was conducted using "diquat", a leaf desiccant supplied by I.C.I.A.N.Z. Ltd. The material was applied as a spray to the cane tops.

Three trials were carried out in each of the following districts—Mossman, Ingham, Lower Burdekin, Mackay and Bundaberg. At each place one trial was conducted in the early part of the harvesting season, one in the middle and one towards the end of this period. The diquat was applied at rates of 2, 2½, 4 and 6 pounds of active ingredient per acre in 100 gallons of water plus wetting agent. The material was applied to the cane tops with ground rigs and, in addition at Mossman and Ingham, aerial applications were carried out by helicopter by courtesy of Messrs. Ansett Barmac Pty. Ltd. Harvesting of trial plots and control areas was by hand except in the case of Mossman and Ingham where Massey Ferguson cane harvesters were used.

It was found essential to wait for six to eight days after application of the desiccant before the treated foliage dried out sufficiently to burn satisfactorily. The material was not translocated in the cane foliage, and high volume applications were essential in order to obtain a good leaf coverage.

With the hand harvested trials the weight of tops of both treated and control areas was determined by weighing as was the weight of the crop. Analyses of c.c.s. were made on samples from all plots. In the case of mechanically harvested cane the crops from the treated and control areas were weighed and crushed at the sugar mills where c.c.s. percentage and extraneous matter estimations were also carried out.

In general, over all the trials, the use of diquat tended to reduce the percentage of cane tops left after the burn, but the c.c.s. of treated cane deteriorated to such an extent as to offset the gains entailed by the small improvement in the extraneous matter position. The two pounds per acre application was as good as the higher rates. The diquat dried out only that part of the foliage with which it came into direct contact. The protected spindle of the cane remained green, as did the midribs of the leaves, and did not burn.

In general, over the series of trials, the c.c.s. percentage of treated cane was reduced by from 0.5-1.0 units and the percentage extraneous matter by from 0-2.0 units.

It was found in accessory trials that the addition of glycerine to the spray mixture allowed the volume of spray per acre applied to be reduced from

100 gallons to 30 gallons and still result in the same effect.

Germination Trials with Cane Setts

A germination trial was conducted at Meringa with the object of determining variation in resistance to heat damage of cane setts treated with hot water at different times of the year. Two times of planting—June and October—were involved. The cane used in each case was taken from the same place in the same fields.

The planting conditions were kept constant in an air conditioned dark room for the two trials. The varieties used were Pindar, Q.50 and Trojan. There were three treatments at each time, namely, control, 15 minutes hot water treatment at 50°C, and 3 hours hot water treatment at 50°C.

The dry weights of resultant shoots and roots were determined in all cases. The results showed that for the 3-hour treatment in all varieties there was a significant increase in the weight of shoots and roots in the October planting compared with the June one. The weights of shoots and roots of the untreated cane decreased significantly from June to October in both the 3 hour and 15 minute treatments.

Stimulation of growth by the 15 minute treatment was significant in both trials.

Legumes and Legume Breeding

There was a pronounced shortage of suitable legume seed for planting in fallows in all areas, and a number of types not generally recommended as being suitable for the particular conditions were used.

Some excellent crops of mung bean were grown in the Babinda area whilst velvet beans and Reeves cowpea gave good results in parts of the Mossman area. The drier weather suited Mung bean, Reeves and Poona peas which normally do not do well in the northern wet season. At Innisfail Mung bean was the most unsatisfactory, and Poona and Reeves cowpeas were not very good. There was insufficient seed available of the recommended Malabar pea. Some excellent crops of Malabar and Havana peas were produced in the Lower Burdekin area. At Bundaberg, Malabar pea was the most satisfactory variety for the season. Velvet beans vined late and weed growth became heavy.

The northern cowpea breeding programme advanced further during the year, and attention was given to selections which performed well in the previous trials.

Most of the forty-seven selections from farm trials were planted on the Meringa Experiment Station for propagation purposes. In the propagation area nearly all the new selections were superior to Reeves, Poona, Black Eye 5, Malabar and Havana, which were planted for comparison purposes. Enough seed of the new varieties was obtained for further trials at Ingham, Innisfail, Babinda, Gordonvale and Mossman.

Best Selections—Six varieties were selected from the 1960-61 trials on their performance in recent and past trials. These are 58NL.246, 253, 452, 459, 558 and 570. The two first-mentioned are derived from the Malabar x Buff family and the other four from Havana x Black Eye 5. The outstanding selection appears to be 58NL.558 which was at the top of the list in all trials. In 1958 it scored 17 compared with the average score of 7 for Reeves cowpea. It behaved similarly in a replicated trial in 1950 in both score and production per acre.

The family Havana x Black Eye 5 appears to be a safe one in regard to nematode resistance due to its good performance in the various F generations and selection trials. Both parents are reputed to be completely resistant to *Phytophthora vignae*. The family Malabar x Buff, however, will have to be watched with care in regard to nematode susceptibility.

Small quantities of seed of the F.9 generation of the six selections will be increased in the Lower Burdekin and the varieties will then be used in commercial harvesting trials in 1962.

Breeding Families—A series of plots of 27 breeding families were planted on the Meringa Experiment Station. These were at the following stages of advancement.

F.3—13 families
F.4— 1 family
F.5— 2 families
F.6—11 families

An excellent young stand of Co.475 on the Mourilyan sands. This variety promises to perform well on poor lands in the Innisfail area.

The F.3 families, Havana x Santiago and Buff x Havana have given excellent crops and have continued growth for six months. Sufficient seed of F.2 generation families derived from second cross pollinations are now available for trials in other Queensland sugar districts. These selections involve blood from the following lines, Black Eye 5, Malabar, Santiago, Buff, Reeves and Havana.

At Mossman the best family in the F.3 series was Buff x Malabar. Others to perform well were Reeves x Buff, Reeves x Malabar, Santiago x Malabar, Buff x Havana and Havana x Santiago.

Introductions—New introductions to trial plots at Meringa were strains of *Canavalia ensiformis, Cyamopsis psoralioides, Phaseolus atropurpureum* and *Vigna marina.*

The new strain of *Canavalia ensiformis* was attractive and continued growth late into the season with a good bulk of green matter. *Vigna marina* is a salt tolerant species introduced from the wild state in the Ingham area.

The so-called "giant" cowpea from the Ingham area was also introduced. A chromosome count showed that this variety is not a polyploid as had been suggested.

Among the 40-sett plots on the Burdekin Station. This seedling cane has Q.67 and Co.475 for parents.

The Sugar Experiment Stations

Managed by:—
G. Bates, Meringa
G. A. Christie, Lower Burdekin
C. G. Story, Mackay
H. G. Knust, Bundaberg

It has been the practice in previous Annual Reports to set out in considerable detail the work conducted on the four Sugar Experiment Stations. This method necessarily led to a degree of duplication. The Experiment Stations are now very largely devoted to seedling raising and selection, and to the conduct of progressive trials associated with varietal improvement. The overall picture of this work is given in sufficient detail in the report of the Division of Plant Breeding and, for that reason—and for reasons of conciseness—the individual Experiment Station reports have been combined in this one section and are being confined to those activities other than seedling work.

Weather and Crops

At the Meringa Experiment Station, near Gordonvale, one of the driest years on record was experienced. From July 1st, 1960 to June 30th, 1961 the total rainfall was 37.01 inches in contrast to the annual average of 73.33 inches; only in the 1946-47 year was the total rainfall lower. The year started off with dry soils following a poor wet season in early 1960, and the first six months from July to December, 1960, was exceptionally dry with crops suffering considerably. From January to June, which includes the wet season, the rain totalled only 29.71 inches, no falls of consequence occurring after March.

This general pattern of precipitation was followed in all centres. At Ayr, where the Lower Burdekin Sugar Experiment Station is situated, the year's rainfall was 20.68 inches against the annual average of 41.75 inches. There again the July to December, 1960, period was exceptionally dry with only 5.97 inches of rain, and the next six months gave only 14.71 inches of which 9.42 fell in February. The Lower Burdekin farms are irrigated, so crop production was ensured, but the lack of the heavy wet season with the flooding of district streams does not augur well for the maintenance of levels in subterranean aquifers—the source of the irrigation water.

In Mackay, the location of the Central Sugar Experiment Station—where the average annual rainfall is 70.71 inches—only 45.01 inches fell. The same climatic design was encountered with a very dry July-December period, a sub-normal wet season with the bulk of the fall in February, and

Bunch planting of seedlings at Bundaberg Experiment Station.

a tapering off to a dry autumn and early winter. The Mackay area also experienced thirteen frosts between early July and mid August, 1960, and—at the other end of the report year—unusually severe frosts in late June, 1961.

The Southern Sugar Experiment Station at Bundaberg experienced weather conditions in line with the other, more-northern centres. Although its average rainfall is 44.33 inches, the year under review had only 31.95 inches. Once again a dry spring and a below average wet season formed the weather pattern, with the heaviest rains in February. Like Mackay, Bundaberg had sharp frosts in both July-August, 1960, and in June, 1961.

District Crops

It is not often that all the State's sugar districts experience similar crop conditions. By virtue of its spread through so many degrees of latitude, and through such a range of rainfall patterns, the sugar industry normally expects sub-normal conditions in one zone to be offset by bounteous or above-average rains in others. But in 1960-61 the crops in all districts were affected adversely by the lateness of starting rains, the lightness and shortness of the wet season and the lower than usual temperatures. The only early crop development was where irrigation was practised; elsewhere growth began only with the end-of-December rainfall.

One result of the dry second-half of 1960 was the very favourable harvesting season with sugar content of cane attaining record levels. And a result of the poor crop growth in the first half of 1961 is that the cane for 1961 harvest is generally erect. There were no floods or cyclonic blows and the crop, though short, is in good physical condition for harvest. The damage caused by frost in the Mackay and more southerly areas is not fully known as yet.

Another effect brought about by the light and short wet season was the opportunity to prepare land and to plant it early. By June, 1961 there was little land left unplanted for 1962 cutting and the excellent tilth and subsequent germinations were a direct effect of the lack of excessive rains.

The crop prospects for 1961 have been dealt with in an earlier section of this report.

Nut Grass Eradication

A few years ago the Experiment Station in the Lower Burdekin was found to be patchily infested with nut grass. Since the Station is not in a flooded area it was considered worthwhile to employ the costly methyl bromide method of eradication, and that has been used as each block became fallow. In addition, along the permanent mill railway line which traverses the Station, and where fumigation is impracticable because of lines and sleepers, the 2,4-D method has been used (2 lb per 100 square feet). It is anticipated that the eradication programme will be completed by the end of this year. The Station will then be

able to conduct all of its experimental work without the interference of nut grass as an additional factor to be considered.

Ratooning Trials at Ayr

Ratooning experiments were carried a little further with the 1960 harvest of two trials on the Lower Burdekin Station. A qualitative unreplicated trial using three commercial varieties was planted in 1956 to determine the reduction in crop which could be expected from successive ratoons under typical farming conditions. The following are yields in tons per acre of cane from four successive crops. After harvesting the third ratoons the trial was abandoned, since the area was required for other purposes.

Variety	Year of Harvest and Crop			
	1957 Plant t.p.a.	1958 1st Rtn. t.p.a.	1959 2nd Rtn. t.p.a.	1960 3rd Rtn. t.p.a.
Trojan	60.43	50.56	37.65	21.51
Pindar	62.32	46.84	35.49	28.14
Q.57	54.31	38.40	36.48	26.04
Means	59.02	45.27	36.54	25.23

No variation in seasonal conditions is taken into account in the above trial, but this is covered in a replicated trial using the same varieties in which plant, first and second ratoons were harvested under one year's seasonal conditions. The following is a summary of the mean yields from the 1960 harvest of this trial:

Farm hygiene is important on an Experiment Station. A small trash fire to sterilize cane knives prevents spread of diseases which can be transmitted mechanically.

Variety	Cane Tons Per Acre				C.c.s.				Sugar Tons Per Acre			
	Plant	1st Rtn.	2nd Rtn.	Mean	Plant	1st Rtn.	2nd Rtn.	Mean	Plant	1st Rtn.	2nd Rtn.	Mean
Trojan	39 54	28.54	27.84	31.98	18 96	18.90	18.90	18 92	7.50	5.39	5.27	6.05
Pindar	40.30	36.75	36.08	37.71	18 40	18 55	18 65	18 54	7.41	6.82	6.73	6.99
Q.57	32.10	30.77	25.05	29.31	17.24	17.06	17.05	17.12	5.52	5.24	4.28	5.02
Means	37.31	32.02	29.66	33.00	18.20	18.17	18.20	18.19	6.81	5.82	5.43	6.02

The above figures demonstrate the excellent ratooning ability of the variety Pindar, for its crop production in ratoons is very high compared with the plant crop. Progressive crop decreases in this trial are connected largely with the age of the cane, there being an interval of 15½ months between planting and harvesting, while the growing period of both first and second ratoons was only 11½ months. Thus, from the above figures, the average crop production per month for the three varieties was as follows:—

Average Tons of Cane Per acre Produced Per Month			
Variety	Plant Cane	1st Ratoons	2nd Ratoons
Trojan	2.55	2.48	2.42
Pindar	2.60	3.20	3.14
Q.57	2.07	2.68	2.18

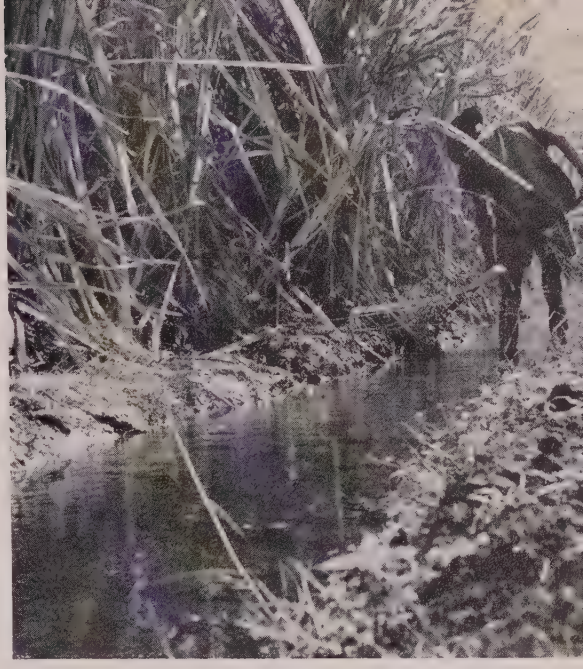
BHC Toxicity Trial at Ayr

The plant crop of the third cycle of this long range trial, designed to compare toxicity from varying amounts of crude and refined BHC was harvested in 1960. Once again there was no significant difference between treatments, and if similar results are obtained from the ratoon crop of this trial to be harvested in 1961, it could be assumed that the regular use of BHC, either as gamma isomer or as the unrefined mixed isomers, will have no toxic effect on sugar cane soils of this area.

Nitrogen from Aqueous Ammonia

A previous trial on the Mackay Sugar Experiment Station, harvested in 1959, had indicated the value of aqueous ammonia in providing nitrogen for sugar cane. The results of a second trial, harvested in 1960, confirmed the possibilities

Q.58 shows good stalk thickness and improved cropping with h.w.t. stocks. This is a plant crop from 1960 treatment —Abergowrie 1961.



Irrigation on Lower Burdekin Station.

of this material in comparison with sulphate of ammonia. Both were applied at a rate equivalent to 80 lb N per acre. The yields obtained gave increases for both aqueous ammonia and sulphate of ammonia above the control plots, which were significant at the one per cent level. There were no significant differences in c.c.s. from either treatment. The cheaper product, aqueous ammonia, has possibilities in a district such as Mackay which has an excellent ocean terminal and an easy access area for bulk installations.

The Effect on Crop of Varying Interspaces

A part of the overall study of mechanizing the cane harvest was the effect of increasing the existing normal interspace width of 4 ft. 6 ins. or 4 ft. 9 ins. Some earlier machines had difficulty in operating with the normal row spacings, and little is known regarding cane yield differences following the growing of modern varieties with interspaces up to five and a half feet. So, at two Experiment Stations, Mackay and Bundaberg, trials were laid down in 1959 with interspaces of four and half, five and five and half feet; and in each case the trial included the interspace treatments superimposed on four of the principal varieties of the district.

In the Mackay experiment there were no yield differences due to interspace width for Q.50 and N.Co.310; but, for Q.58, the five feet interspace yielded significantly higher than the five and a half feet at the five per cent level; and, for Q.63, the five feet spacing was better than either of the other two at the same level.

At Bundaberg C.P.29-116 and Vesta showed no significant differences but, for Q.50, the four and a half feet spacing was significantly superior to the others; and, for N.Co.310, the five feet spacing was significantly better than the four and a half feet.

A clearer picture will emerge when yields from the first and second ratoon crops are known.

Nitrogen *cum* Varietal Response Trial

This experiment was designed to discover whether, of two varieties—N.Co.310 and C.P.29-116—the response to nitrogen fertilization varied. The trial took the form of a double 5 x 5 Latin square with one square devoted to each variety and the nitrogen treatments covering control and one, two, three, four cwts of sulphate of ammonia per acre. Prior to planting in March, 1959 a well-nodulated crop of cowpeas was ploughed in and, at planting, the field received 3 cwt per acre of Sugar Bureau No. 3 Planting Mixture. The varying dressings of nitrogen were made in early November, 1959. The crop was harvested at the end of October, 1960—some 19 months after planting.

Despite the excellent legume crop, there was a fair response to the additional nitrogen, the yields varying—for N.Co.310—from 55.8 tons per acre for the controls to 63.7, and—for C.P.29-116—from 66.4 for the controls to 71.5 tons per acre for the heavy nitrogen dressing. For the former variety the two, three and four cwt dressings were better than the control at the one per cent level of

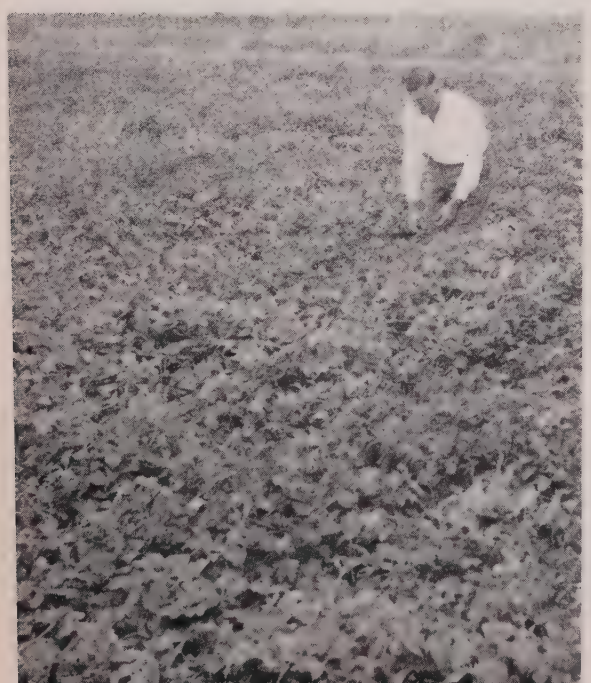
Composition of Tops and Millable Cane of the Varieties N.Co.310 and C.P.29/116 at Two Levels of Nitrogen

Variety	N Applied per ac. lb.	Yield of Millable cane (tons per acre)	Composition of tops per cent. dry matter			Composition of millable cane per cent. dry matter			Nutrients in crop (millable cane plus tops) lb. per acre		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
N.Co.310	nil	56	0.63	0.179	1.40	0.16	0.077	0.51	81	36	246
N.Co.310	92	62	0.69	0.180	1.36	0.20	0.062	0.48	112	33	260
C.P.29/116 ..	nil	66	0.60	0.158	1.31	0.14	0.074	0.35	88	46	237
C.P.29/116 ..	92	71	0.74	0.197	1.40	0.24	0.075	0.39	150	46	247

significance, and the one cwt dressing also exceeded the control at the five per cent level. For the C.P.29-116 all nitrogen levels were superior to the control at the one per cent level. There were no differences in sugar content. The experiment has been carried forward into the ratoon crop.

N. P_2O_5 and K_2O content of the two varieties—This nitrogen trial provided the opportunity to compare the amount of plant nutrient taken from the soil by each of the two varieties. When the crop was approximately 18 months old (just prior to harvest) the tops and millable cane from the nil and the 4 cwt sulphate of ammonia plots were sampled and analysed for moisture, N, P and K.

The results are summarized in the table given herewith. In general there was not a great deal of difference between the two varieties but it is of interest to note that the increases in both stalk and leaf nitrogen content with increased nitrogen application were greater with C.P.29-116 than with N.Co.310.



A crop of the cowpea Blackeye 5 on Mackay Experiment Station.

Third Cycle Phosphate Trial

The plant crop of the third cycle of the phosphate trial at Mackay Experiment Station was harvested during the year. It is of interest to review the results to date since these now apply to six crops of cane, the first of which was harvested in 1953.

As the result of past fertilizing practices the soil of the trial area contained reasonably good amounts of available phosphate and a major objective was to determine the rate of depletion of this plant food. The amount of response to added phosphate was also of interest, as was also the possibility of differences due to the use of superphosphate versus finely ground rock phosphate. In addition it was felt that useful information might be obtained by comparing the application of rock phosphate as an annual dressing with its usage when the same amount, which would normally be spread over the several crops of the cycle, was applied in one application to the first crop. This latter was further varied by substituting superphosphate for a portion of the rock phosphate, the amount of substitution being equivalent to the P_2O_5 allocated for one crop. All crops received equal and adequate

First-year seedlings at harvest time on Mackay Station.

amounts of N and K and the variations in phosphate applications per acre, were as follows:—,

1. nil P_2O_5
2. 50 lb P_2O_5 applied to each crop as superphosphate
3. 100 lb P_2O_5 applied to each crop as superphosphate
4. 50 lb P_2O_5 applied to each crop as rock phosphate
5. Rock phosphate applied to first crop of each cycle *i.e.* 100 lb P_2O_5 to the first of the two crops of Cycle 1, and 150 lb P_2O_5 to the first of the three crops of Cycles 2 and 3
6. As for 5, except that Cycle 1 received 50 lb P_2O_5 as superphosphate and 50 lb P_2O_5 as rock phosphate. Cycles 3 and 4 received 50 lb P_2O_5 as superphosphate and 100 lb P_2O_5 as rock phosphate.

The variation between treatments 5 and 6 was designed to investigate the possibility that the rock phosphate might not release available P quickly enough to satisfy the needs of the first crop, hence the substitution of superphosphate for portion of the rock phosphate.

In summing up the results of the six crops now harvested it is clear that there has been no response to added phosphate, in whatever amount or form it was applied. This was true with regard to both cane tonnage and c.c.s. The accompanying table shows the tons of cane per acre for the various treatments.

It seems evident therefore that throughout the period of the trial the soil content of available phosphate has been sufficient to supply the requirement of the six crops which have been harvested to date. Therefore it is of interest to look at the figures for available P_2O_5 content of the soil from the variously treated plots. Soil samples were taken in early November, 1952, prior to the commencement of the trial, in early September, 1955, just prior to planting the second cycle, and at the end of August, 1959, immediately

Phosphate Trial, Yields, tons per acre.

Treatment (see details in text)	Class of Crop and Year of Harvest					
	First Ratoon 1953	Second Ratoon 1954	Plant 1956	First Ratoon 1957	Second Ratoon 1958	Plant 1960
1. (nil phosphate)	25	22	26	28	25	26
2. (super)	24	22	24	25	22	21
3. (super)	26	23	26	26	24	23
4. (rock phosphate)	28	23	26	27	25	22
5. (rock phosphate)	26	20	22	24	21	22
6. (super plus rock phosphate)	26	23	25	28	24	23

Extending the underground irrigation main on Meringa Station.

before planting the third cycle. At each sampling, duplicate analyses were made on the samples taken from each of the replicates of the trial (6 x 6 latin square) and therefore the figures shown in the accompanying table are means of 12 analyses.

The plots receiving no phosphate dropped from 63 to 39 and then to 35 p.p.m. P_2O_5 from the commencement of the trial in 1952 to the last analysis in 1959. It is important to note that this decrease was not accompanied by a fall in crop yields. Plots receiving 50 lb P_2O_5 per acre per crop *i.e.* 250 lb prior to the 1959 analysis, behaved somewhat similarly (61,41,49) but to a lesser degree, again with no detectable lowering of yields. The plots receiving the double amount of P_2O_5 (100 lb per acre per crop) showed a marked increase by the 1959 analysis, but the reason for this trend not appearing in 1955 is not clear. The plots receiving straight rock phosphate (treatments 4 and 5) maintained a fairly constant level of P_2O_5, there being little difference between the initial analyses in 1952 and the last in 1959. Treatment 6 which also received a total of 250 lb P_2O_5 by 1959, but which was composed of 100 lb P_2O_5 as superphosphate and 150 lb P_2O_5 as rock phosphate, reacted somewhat similarly to treatment 2, the soil P_2O_5 ranging from 71 p.p.m. initially to 38 in 1955 and 46 in 1959.

While it may be unprofitable to indulge in over much speculation as to what has happened to the applied phosphate, the highly significant differences obtained in the 1959 analyses are not without interest. The accumulation of 95 p.p.m. of available P_2O_5 in the plots which had received 500 lb per acre P_2O_5 as superphosphate is but 60 p.p.m. more than the content of the plots receiving no phosphate. Admittedly it is difficult under these field conditions to calculate a 500 lb application in terms of p.p.m. of soil, but it might be considered to be at least equivalent to 200 p.p.m. This being so it seems that a substantial portion of the applied superphosphate has either been rendered unavailable, absorbed as luxury feeding by the crop or lost in some other fashion.

Phosphate Trial, Amount of Available P_2O_5 in Soil in 1952, 1955 and 1959.

Treatment (see details in text)	Initial Soil P_2O_5 prior to commencement of trial (p.p.m.)	Amount P_2O_5 applied prior to 1955 analysis (lb. p.ac.)	Soil P_2O_5 in 1955 (p.p.m.)	Amount P_2O_5 applied prior to 1959 analysis (lb. p.ac.)	Soil P_2O_5 in 1959 (p.p.m.)
1. (nil phosphate)	63	nil	39	nil	35
2. (super)	61	100	41	250	49
3. (super)	57	200	50	500	*95
4. (rock phosphate)	56	100	47	250	**57
5. (rock phosphate)	62	100	40	250	***67
6. (super plus rock phosphate)	71	100	38	250	46

* Significantly greater (1 per cent. level) than treatments 1, 2, 4, 5, 6.
** Significantly greater (1 per cent. level) than treatment 1.
*** Significantly greater (1 per cent. level) than treatment 1; greater than treatments 2, 6 (5 per cent. level)

A fine stand of Q.70 at Bundaberg. This variety is performing well in several districts.

That a portion of the rock phosphate P_2O_5 has become "available" is also evident, otherwise it might be expected that the 1959 analyses of treatments 4 and 5 would be the same as that for treatment 1, *i.e.* the nil phosphate application. However since 250 lb P_2O_5 per acre should be equivalent to approximately 100 p.p.m. in soil, the finding of only 57 and 67 p.p.m. again indicates a discrepancy which could be due to a variety of causes.

The trial will be continued and further yields and analytical figures should be of interest.

New Cowpeas for Industry

The legume breeding project, started a few years ago at Meringa, has progressed steadily and satisfactorily. In the report of the Division of Soils and Agronomy earlier in this volume, some of the work in North Queensland is detailed. There it has spread beyond the Experiment Station onto district farming properties, and the original large numbers of new legume varieties have been whittled down by selection and trial to numbers which can be handled and observed more readily. On the Meringa Experiment Station itself both F.3 and F.6 families were propagated during the year. Selections from the cross Havana x Black Eye No. 5 showed considerable promise.

At the Lower Burdekin Experiment Station the 436 varieties being grown were reduced to 75 by careful selection and these last-mentioned are planted in observation plots for further selection, and, finally, for yield trials.

In Mackay a similar procedure has been followed. In the last selection the number was reduced from 714 to 140 representing varieties from eleven crosses. Some weighings were made of above-ground material in some of the crosses

In the green-manure breeding programme it takes years of planting and replanting to purify the varieties. These are seed samples of some of the types which are nearly ready for commercial production.

Q.66 in Herbertvale area where its lodging resistance is very valuable.

and the weights ranged from 17.9 to 21.2 tons per acre for the four heaviest. The varieties Blackeye 5, Malabar and Santiago, which were interplanted with the families, all performed well but none outyielded the families. Another batch of selections in Mackay constituted 27 individuals which had been planted in May, 1960, had survived frosts and dry conditions and which had grown for twelve months. A feature of these was the heavy root system and thick main stem.

At Bundaberg 54 selections were made from the F.7 generation of eleven crosses in the cowpea observation trial. These are to be included in a replicated yield trial in 1961-62. The principal features of the families selected were long-period cover, and the extension of that cover into the winter months. This was characteristic, in particular, of the families containing C.P.I.12153 or Malabar.

Another phase of the Bureau's legume work has been the examination and testing of a wide range of collected green manure varieties with the aim of obtaining superior types to those now being grown. This was necessary to satisfy the industry's requirements partially before the Bureau's breeding programme bore fruit. The outcome of this work has been the selection of Malabar cowpea as superior to types being presently grown commercially. But some years have been wasted due to the indifference of commercial seed growers. Now the Bureau has managed to interest several Lower Burdekin farmers in producing seed of Malabar Pea and in both 1960 and 1961 the demand far exceeded the supply. The

5553 Shows promise on the Abergowrie brown forest soils.

Bureau is particularly interested in this development since it will need the co-operation of commercial seed growers in establishing the products of its breeding work—and that will need to begin in the near future.

Field Days

As part of the Bureau's extension service the annual Field Days were conducted on each Experiment Station during the first half of 1961. The Bundaberg one was run concurrently with the Conference of the Queensland Society of Sugar Cane Technologists in that city, and the others just prior to the commencement of the harvesting season. Successful field days were held at each centre although, due to widespread planting in the districts, attendances were below normal at Meringa and Mackay.

Field Days on agricultural experiment stations must, of necessity, follow a certain pattern and it is difficult to introduce new and interesting features each year. It is essential, for example, that groups of visiting growers be taken around the Station to see the various fields. In other pursuits—such as pastoral industries—the animals can be paraded before the audience and demonstrations given under novel conditions. This cannot be done with a growing crop, but an effort is made on each occasion to have some new and topical feature, whether it be a cane harvester or loader, a new topper or fertilizer distributor, or demonstrations of disease symptoms or weed pests. About one quarter of the State's cane growers attend each year at the annual field days.

Abstract of Meteorological Observations made at the Northern Sugar Experiment Station, Gordonvale, from 1st July, 1960, to 30th June, 1961.

Month	Rainfall (inches)	No. of Wet Days	Shade Temperatures						Mean Diurnal Range	Mean Temp 9 a.m.	Mean per cent Relative Humidity 9 a.m.	Average Daily Hours Sunshine (Unctd.)
			Maximum			Minimum						
			High	Low	Mean	High	Low	Mean				
1960												
July	0.49	12	81	65	73.1	68	41	56.2	16.8	66.0	78.8	6.12
August	0.05	2	84	70	77.1	66	45	57.3	19.8	69.2	70.9	6.09
September	0.19	2	92	80	83.9	70	48	59.9	24.0	75.8	57.5	8.53
October	0.03	1	92	80	87.1	72	58	64.8	22 3	80.3	57.9	8.76
November	0.22	4	94	87	90.3	74	60	69 2	21.0	83.0	56.4	8.12
December	6.32	12	102	82	89.6	74	63	69 6	20.1	82.4	63.3	7.42
1961												
January	8.49	12	92	80	85.9	75	63	69.8	16.1	80.5	71.0	7.58
February	5.59	13	94	84	89.2	77	66	72 9	16.3	82.3	74.7	7.59
March	9.79	12	91	79	85.8	75	61	67 9	17 8	77.9	77.8	7.38
April	3.38	21	86	76	82.2	75	64	69.1	13.1	76.9	79.7	6.8
May	2.37	14	82	72	77.9	70	55	63.5	14 5	71.6	76.8	5.23
June	0.09	4	82	69	78.0	63	45	54.8	23.2	67.7	72.8	7.42
Totals	37.01	109										

Average annual rainfall for July to June period for 37 years: 73 33 in.

Abstract of Meteorological Observations made at the Lower Burdekin Sugar Experiment Station, from 1st July, 1960, to 30th June, 1961.

Month	Rainfall (inches)	No. of Wet Days	Shade Temperatures						Mean Diurnal Range	Mean Temp 9 a.m.	Mean per cent Rel. Humidity 9 a.m.
			Maximum			Minimum					
			High	Low	Mean	High	Low	Mean			
1960											
July	0.18	2	86	67	76.0	57	39	48.5	27.5	64.0	63.4
August	0.41	3	86	72	77.5	66	40	52.7	24.8	67.3	65.1
September	0.11	2	93	78	83.0	70	47	56.9	26.1	74 9	61.9
October	0.26	3	91	83	86.5	70	57	64.2	22.2	80 5	62.2
November	2.29	3	94	83	87.0	80	58	69.7	17.3	82.4	65.4
December	2.72	7	100	83	88.8	73	63	68.3	20.6	82.4	64.8
1961											
January	2.92	7	92	85	87.6	75	63	67.5	20.1	81.7	67.0
February	9.42	12	92	83	88.8	78	68	73.0	15.8	83.0	74.6
March	1.77	5	90	81	86.4	75	62	67.6	18.8	80.7	71.7
April	0.18	3	89	81	85.1	70	58	65.3	19.8	79.7	70.2
May	0 42	4	86	74	80.5	67	44	56.8	23.7	71.8	63.7
June	..	..	84	67	78.4	59	41	50.6	27.7	67.0	63.6
Totals	20.68	51									

Average annual rainfall for July to June period: 41.75 in.

Abstract of Meteorological Observations made at the Central Sugar Experiment Station, from 1st July, 1960 to 30th June, 1961.

Month	Rainfall (inches)	No. of Wet Days	Shade Temperatures						Mean Diurnal Range	Mean Temp 9 a.m.	Mean per cent Rel. Humidity 9 a.m.
			Maximum			Minimum					
			High	Low	Mean	High	Low	Mean			
1960											
July	0.67	7	83	62	72.2	59	35	48.3	23.9	61.8	77.8
August	0.03	1	81	65	74.0	58	36	47.5	26.5	64.7	63.5
September	0.35	1	91	74	80.5	64	41	53.7	26.8	73.3	54.7
October	0.03	1	89	79	84.1	71	54	61.4	22.7	79.0	61.6
November	3.82	6	89	80	85.2	73	51	65.1	20.2	80.6	60.3
December	6.87	8	96	81	86.2	74	60	67.0	19.1	81.7	62.5
1961											
January	3.58	15	88	80	83.4	75	63	67.8	15.5	78.8	71.6
February	19.79	11	95	75	85.6	75	62	69.8	15.8	80.1	78.3
March	2.82	11	87	75	82.8	74	58	66.3	16.5	76.9	78.3
April	4.05	17	86	76	80.9	73	57	65.1	15.9	75.6	79.6
May	1.61	8	82	71	75.2	65	40	54.6	20.6	67.4	76.3
June	1.39	2	80	59	73.4	64	30	47.6	25.8	63.9	68.7
Totals	45.01	88									

Average annual rainfall for July to June period for 26 years: 70.71 in.

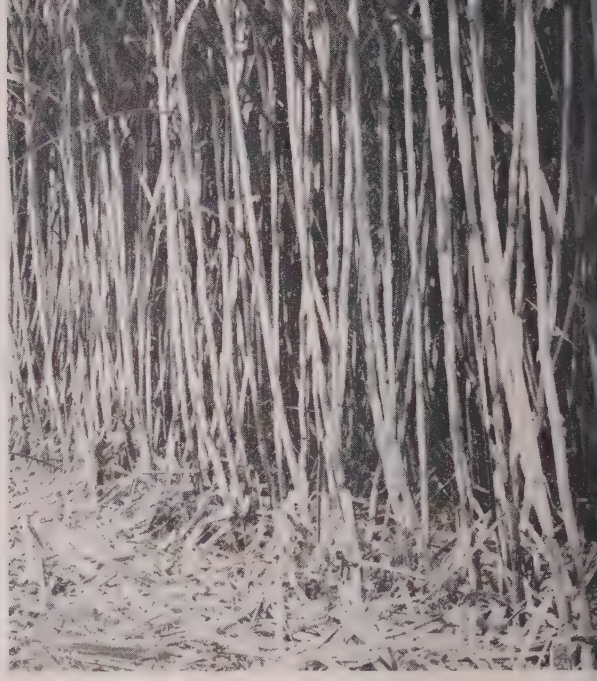
Abstract of Meteorological Observations made at the Southern Sugar Experiment Station, Bundaberg, from 1st July, 1960, to 30th June, 1961.

Month	Rainfall (inches)	No. of Wet Days	Shade Temperatures						Mean Diurnal Range	Mean Temp 9 a.m.	Mean per cent Rel. Humidity 9 a.m.
			Maximum			Minimum					
			High	Low	Mean	High	Low	Mean			
1960											
July	0.33	5	76	62	69.4	58	33	46.4	22.9	55.7	79.3
August	0.95	2	76	65	70.7	62	33	43.0	27.7	60.3	73.0
September	0.42	4	85	71	76.4	67	44	53.0	23.4	68.3	69.4
October	0.98	4	87	76	80.7	70	50	61.0	19.7	74.6	71.0
November	0.72	5	88	78	82.8	72	50	64.3	18.5	73.1	68.4
December	2.40	6	92	76	84.9	72	58	66.2	18.6	78.3	79.2
1961											
January	6.32	13	86	78	82.6	72	62	66.4	16.2	77.1	77.3
February	11.90	12	89	72	80.5	74	62	68.2	12.3	78.3	82.2
March	5.68	12	84	75	81.3	70	59	65.1	16.2	76.6	77.0
April	0.72	6	84	76	78.6	66	52	60.8	17.8	73.4	75.9
May	1.18	6	78	71	76 6	62	40	51.7	24.9	65.1	73.8
June	0.35	2	76	62	68.4	60	36	46.0	22.4	60.1	69.1
Totals	31.95	77									

Average annual rainfall for July to June period for 46 years: 44.33 in.

Cane Grown and Harvested on Experiment Stations in 1960 Season

Location	Tons Cane Produced	Acres Harvested	Tons Cane per acre	Average c.c.s.
Meringa	921.7	27.8	33.1	14.95
Burdekin	995.2	29.0	34.4	15.93
Mackay	725.7	31.7	22.9	16.18
Bunda-berg	1229.9	25.7	47.8	15.19



54N.6441 (now Q.75), seven months old, at Fig Tree Creek. A new variety which will be approved in the far north next year.

Division of Plant Breeding

J. H. Buzacott, Sen. Plant Breeder
Associated with
J. C. Skinner, Sen. Geneticist

Introduction

The cane breeding programme is now undergoing a period of consolidation following the recent expansion of its activities. With sub-stations functioning at Innisfail, Tully, Ingham, Moreton-Maryborough and Childers, quarantine introduction plots at Millaroo and Beerwah, and introduction plots in all mill areas, the farm selection and dissemination of new varieties is well catered for and it is now felt that every sugar growing district in the state has a better opportunity to share in the selection of varietal types to suit its particular environment.

Investigational work has been continued with the accent still on methods of selection, although methods of improving the technique of cross-pollination are still receiving close attention.

Cross Pollination

There was a poor flowering season in 1961 and this was associated with the near record drought experienced prior to and during the flowering period. Some important parents did not produce any flowers, and the Freshwater Breeding Plot, which normally flowers freely, produced no worthwhile material this year. Pollen showed viability tests which were higher than usual but, following germination tests, it is now evident that seed set in some crosses was poor. This was most noticeable in crosses with Co.270, a valuable parent, which appears to have performed badly this year either as a male or a female. As a result of the abnormal flowering, less proven crosses than desired were made but, to compensate, many more experimental crosses than usual were effected. However, in spite of the poor crossing season there is adequate seed from former years in frozen storage to supply the planting requirements of all stations.

The first cross of the season was erected on the 19th May and the final cross on the 19th June. The total number made was 406, which included two large area crosses and a number of crosses made to test the effect of waterproofing lanterns, snap freezing of pollen and other experimental work. Varieties introduced to the cross-pollination programme for the first time included N.685, Q.71 and Triton.

Pollen Testing

For some years iodine has been used as a stain to indicate the viability of pollen. Whilst it is realised that the starch content is not necessarily a reliable guide to pollen viability it has been found that, from a practical point of view, the iodine test has considerable value. Following the development of a technique known as the peroxidase test for pollen viability in Louisiana, this method

Sorting packed cane seed ready for despatch to other stations.

was tested this year in comparison with the iodine method. The peroxidase test utilises benzidine as the stain and is claimed to indicate more accurately the degree of viability of pollen according to the depth of stain developed in the pollen grains. Pollen tested by both methods was used in crosses and when the seed from these crosses is germinated the relative value of the two methods can be assessed. In general, however, there was a fairly close agreement in viability as indicated by the two tests.

Pollen Storage

Following communications with Professor J. R. King, of Louisiana State University, regarding the snap freezing of pollen and subsequent storage in an atmosphere of nitrogen, samples of sugar cane pollen so treated were received from him. Professor King requested our co-operation in making crosses with this pollen to determine whether it had maintained its viability. The pollen was used to make crosses some months after its receipt. Although lack of germination indicated that no seed was set, iodine and peroxidase tests indicated that the pollen possessed a high degree of viability. It is possible that the poor seed set which occurred with a number of varieties this year may account for the failure of this stored pollen, since a control test of the female variety used in the experiments showed that it failed to produce seed when fertilized with pollen from a mormally strong male variety. It is likely that further tests of the method will be made since it has proved successful for storing pollen from other plants.

Modifications of Technique.

The crossing solution was increased in strength this year by 50 per cent in accordance with the discovery in Hawaii that the stronger solution gave better results. Further experiments were also carried out in waterproofing lanterns; the materials used were aluminium acetate, a paraffin emulsion and a silicone compound. The aluminium acetate method was unsuccessful due to difficulty in achieving solution whilst, of the two other compounds, the silicone substance gave the better waterproofing. However, it was a dry crossing period and these experiments must be continued until a wet year is experienced, when a true assessment can be made of mould prevention and seed setting in the treated lanterns.

Certain groups of the lanterns were also covered with clear plastic roofing material. The performance of crosses under these lanterns will be compared with that under unroofed lanterns and under those roofed with galvanized iron. Again this experiment will have to be continued until a wet crossing year is experienced before a proper assessment of the value of plastic roofing can be made.

Control of Flowering

Further experiments were conducted into the control of flowering by CMU and maleic hydrazide. The most interesting effect noted was that, whereas neither CMU nor maleic hydrazide applied in January showed any effect on the flowering, where

both materials were applied the flowering of one variety, N.Co.310, was completely inhibited. Applications of CMU were again unsuccessful in inducing flowering.

Experimental work on the gravimorphic induction of flowering was carried a stage further. This year several varieties were grown in five-gallon drums for the purpose. The drums were laid in the horizontal position and the cane kept growing in that way by rotating the drums 180 degrees each day for some three months prior to flowering. This had a very depressing effect on the growth of the cane and arrowing induction did not occur in the canes so treated.

Seedling Raising

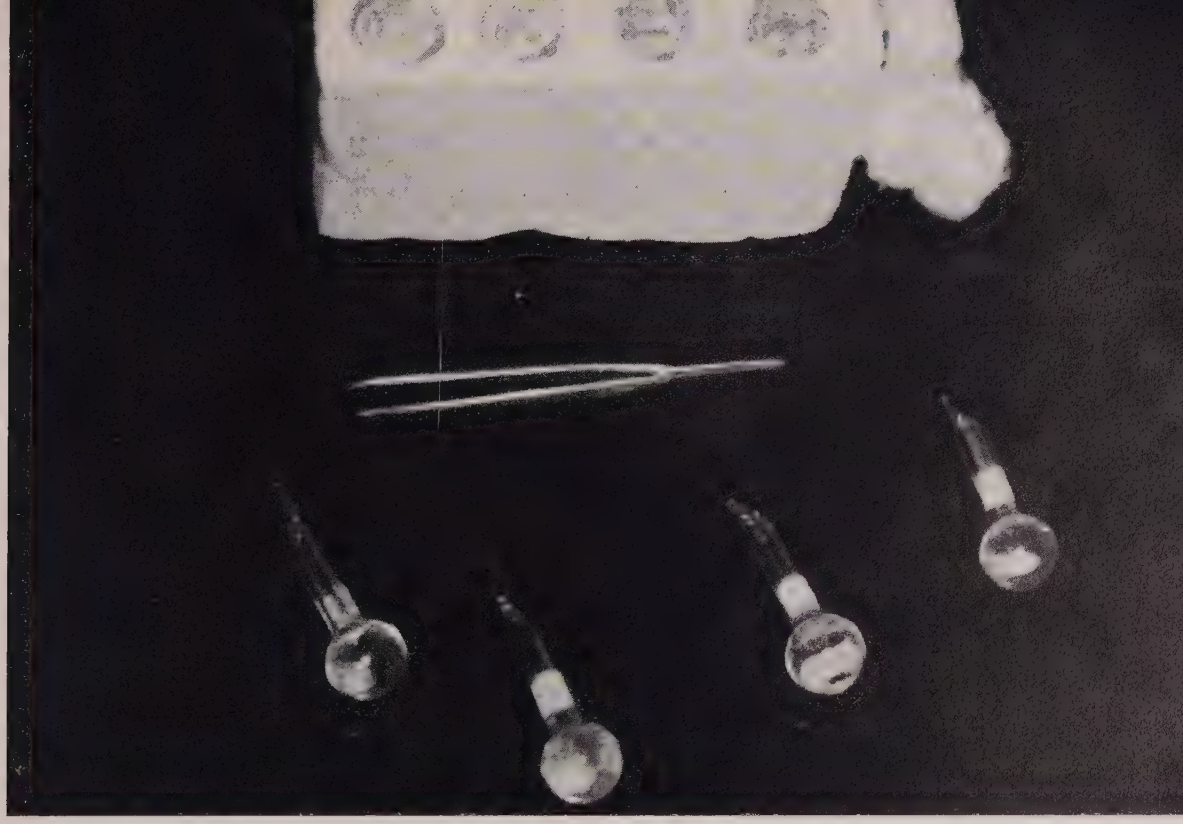
A reasonable germination was achieved at all stations. Electrical heating is in operation in the glasshouses at Bundaberg, the Burdekin and Meringa, whilst at Mackay, where seedlings are raised in the summer months, artificial heat is not necessary for seedling raising.

At the Northern Experiment Station, 8,881 seedlings were single-planted and approximately 23,790 in bunches. At the Lower Burdekin, 3,776 seedlings were single-planted and approximately 14,260 in bunches. All seedlings, totalling 6,587, were single-planted at Mackay, whilst at Bundaberg the numbers were 5,897 single seedlings and 5,200 in bunches. Accordingly, the approximate total planting of seedlings for the year in all four field stations was 68,500.

Selection

As in the previous year there was a complicated programme of selection on the Northern Sugar Experiment Station where 4,518 selections, 1,144 of which were from bunch-planting, were planted

Tying lantern covers on to frames prior to cross-pollination.



Ampoules of sugar cane pollen stored in nitrogen were received from the United States.

in 4-sett plots; 504 ,which included 156 rich land selections, were planted in 30-sett plots and 46 in replicated yield-observation trials. In addition, a selection rate experiment, using three crosses with four rates of selection, was planted.

At the Lower Burdekin, 7,000 varieties were taken from bunch-plantings and planted in 2-sett plots, whilst 263 selections were planted in 4-sett plots, 181 in 40-sett plots and eight in a replicated yield-observation trial.

Selection at Mackay yielded 854 4-sett plots, 103 30-sett plots and 55 varieties for replicated yield-observation trials, whilst at Bundaberg 186 varieties were selected for planting in 4-sett plots, 188 for 30-sett plots and 34 for a replicated yield-observation trial.

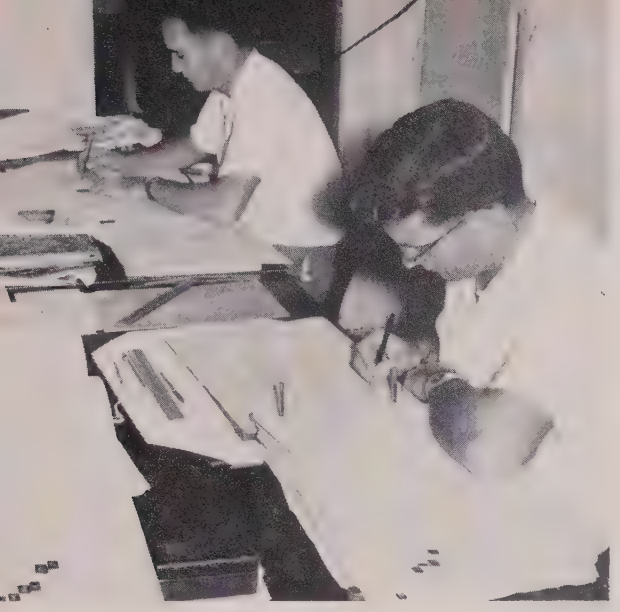
Sub-stations

Sub-stations or large scale introduction plots are now functioning in Innisfail, Tully, Ingham, Childers and the Moreton-Maryborough districts. At Innisfail during 1960, there were planted 975 2-sett plots, 134 4-sett, 120 30-sett and 21 180-sett. At Tully 43 introductions from the Innisfail sub-station were planted in 30-sett plots. At Ingham the planting included 140 introductions from Meringa, 24 from the Burdekin and eight from Bundaberg, whilst from 18 selections of the previous year six were re-selected for further trials.

The Childers Introduction Plot provided 11 selections from 30-sett plots which were planted in a replicated trial and in the Moreton district 67 varieties were planted in an introduction plot at Maroochy River and 54 in a similar plot at Woombye. Twenty-five selections from introduction plots were planted in 30-sett plots.

Rich Land Varieties

Special selection plots for rich land varieties were planted at the Northern Sugar Experiment Station and on rich land on the Mulgrave River. On the former site, 156 varieties were planted and 159 at the latter. In each instance the varieties were planted in 30-sett plots. Unfortunately these



Entering the performance of selections at other stations into the complete records held at Meringa.

varieties were selected almost entirely from the cross Q.67 x M.336, which is one of the few crosses which produces a reasonable number of anti-lodging types with a high sugar content. Whilst the seedlings from Q.67 x M.336 are of good type, the general susceptibility of the cross to leaf scald will provide a serious impediment to the development of rich land canes from this cross. When other crosses which produce anti-lodging varieties are developed, the chances of producing more commercial anti-lodging varieties will be much greater. This, however, will not be easy as, not only are varieties which transmit lodging resistance rare, but they also often appear to carry a susceptibility to leaf scald which is transmitted. This definitely occurs with three of our varieties Q.27, Q.66 and Q.67 which, up to the present, have proved our best parents for lodging resistant varieties.

Legume Breeding

As a result of eight trials in the far north ranging from Ingham to Mossman, six selections from the cowpea crosses have been made and these are now each being propagated from a single pod of F8 generation seed. At the other stations, selections in earlier generations are still being made and at the Northern Experiment Station further F1 crosses were established whilst some F3 seed was harvested and F4 seed is ready to pick.

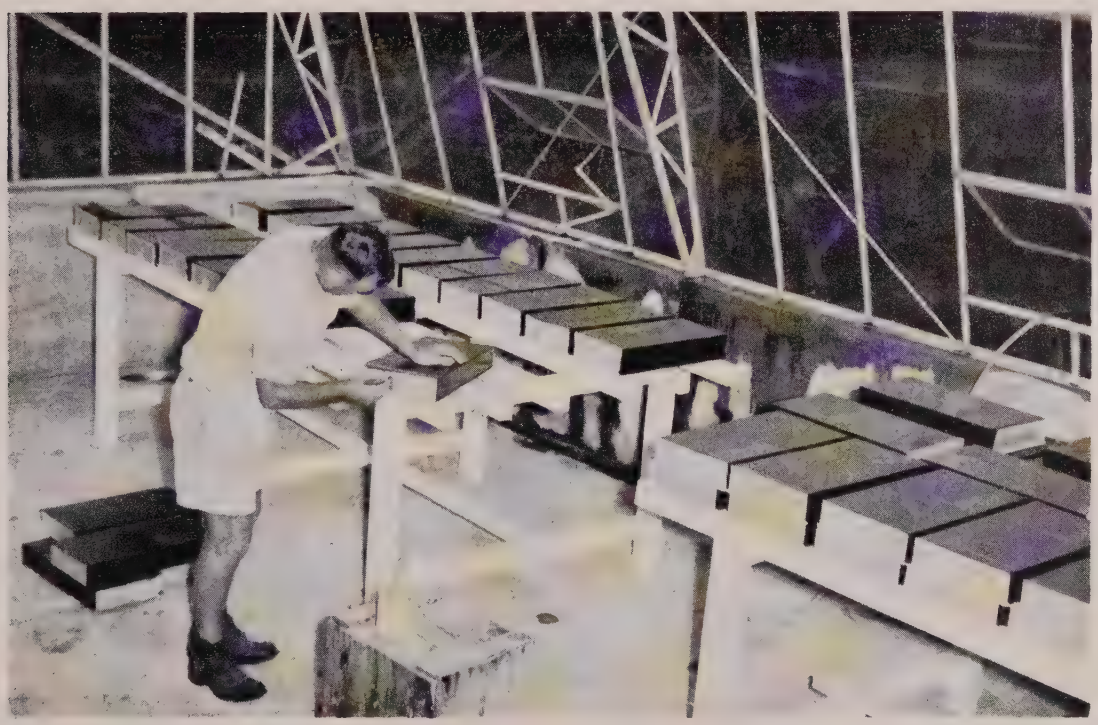
Varietal Statistics

Pindar, for the third year in succession, achieved the status of leading variety in the state and, in producing approximately one-fifth of the total crop, was 450,000 tons ahead of Q.50, its closest rival. The latter variety has now, to a very large extent, been replaced in the central district by the newer varieties Q.58, Q.63 and Q.68, whilst N.Co.310 has also taken toll of it there to the extent of over 100,000 tons. Trojan, still in third position, lost ground north of Townsville but maintained its popularity in the Burdekin district. However, with a crop of 1,144,000 tons, it is now only 250,000 tons ahead of its nearest competitor, Q.57. This variety, after suffering a recession in the Burdekin district, is making steady progress north of Townsville and now provides almost one-quarter of the total crop in those districts. As the Innisfail and Ingham districts are planting still greater areas of Q.57, it seems likely that it may, in the near future, displace Trojan as third variety in the state. Q.58, with larger plantings over most of the state, except the far north, achieved in 1960 a considerable lead over N.Co.310, with which it has been running very close in recent years. However, the latter variety is gaining more ground in the central district than Q.58 is in the south and it may well be that the relative positions of these two varieties may be reversed in the near future. Badila, C.P.29-116 and Q.63 have maintained their places in seventh, eighth and ninth positions respectively but there is some indication that C.P.29-116, the plantings of which have been slowly diminishing, may undergo a resurge of popularity following the bad drought of 1961, when its drought resistance has shown up so well, although this may be offset to some extent, particularly in the Isis district, by increased plantings of the drought-resistant varieties Q.69 and Q.72.

Vesta, the only other variety to reach two per cent of the total crop, hurdled Q.59, Vidar, Q.61 and Q.44; in fact the latter dropped from thirteenth to eighteenth place and, with only 55,000 tons harvested in 1960, seems to be on the way out. Other varieties to make a rapid improvement in popularity are Q.70, which moved from seventeenth to fourteenth place, Q.68 which progressed from eighteenth to sixteenth and Q.67 which, from twenty-fifth place in 1959, achieved seventeenth position in 1960, whilst Q.55 and Q.65 also markedly improved their positions.

A number of varieties appeared on the crushing list for the first time. These are Q.62, Q.69, Q.71, Q.73 and Damon. Of these, Q.73, with a crushing of 19,500 tons in the central district, heads the list. Of the varieties listed in 1959 there is none which does not appear in 1960. However, a number appear destined to disappear at an early date and are represented by less than a thousand tons. These include E.K.28, Co.290 and Q.45, whilst less than 3,000 tons of the once important Clark's Seedling is now grown and Cato is down to a figure almost as low.

It is pleasing to record the performance of modern "Q" varieties. Of the 48 varieties listed in the 1960 crushing list, no less than 25 are "Q" varieties bred by the Bureau of Sugar Experiment Stations, two are S.J. varieties bred by the same institution, 14 are C.S.R. bred and seven are overseas introductions. As far as tonnage is concerned, of the total of 8,685,426 tons crushed, 84.2 per cent developed from Queensland-bred varieties and 15.8 per cent from overseas varieties. N.Co.310, Badila and C.P.29-116 were by far the greatest contributors to this latter fraction and South Africa, New Guinea and the United States rank in the same order as last year with regard to the percentage of the crop from introduced varieties. The tonnage crushed of the Indian



Seedling flats are painted each year to maintain them in good condition.

Pollen viability is tested daily during cross-pollination.

variety, Co.475, has increased considerably, largely on account of its good performance in Hambledon, Mulgrave and on the northern end of the Babinda mill area where it has to some extent replaced Q.44. However, Co.475 is expected to have a fairly short popularity as new seedlings are released for these areas.

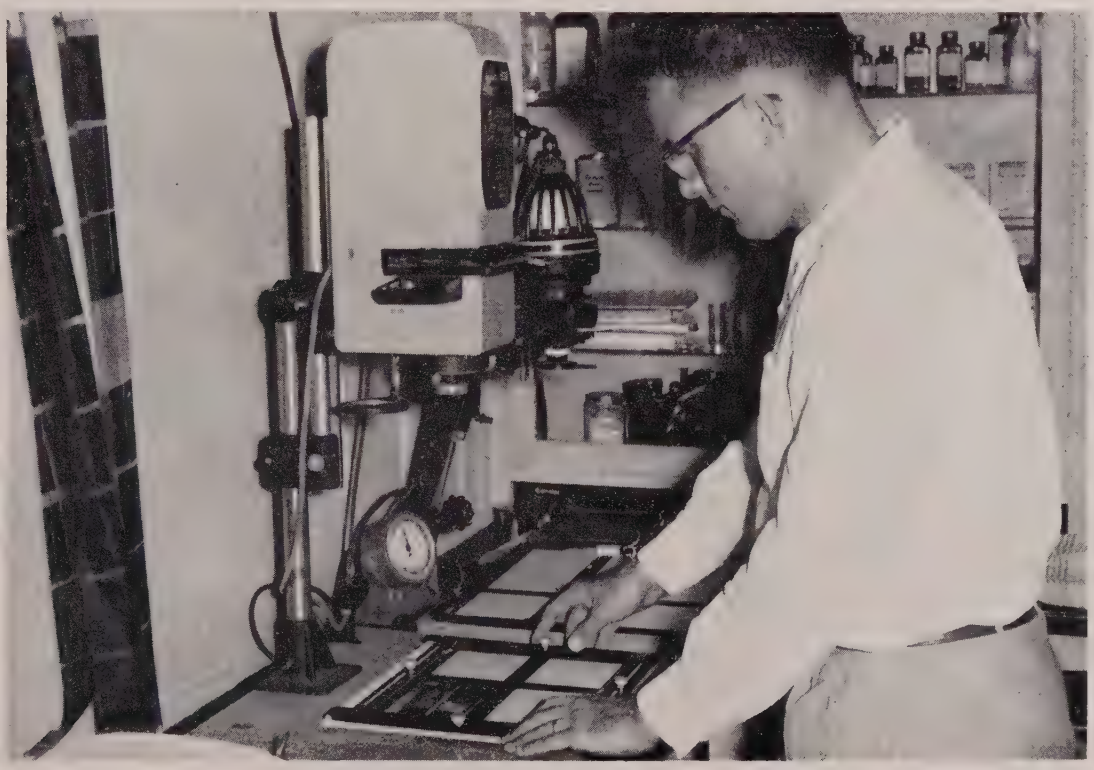
New Varieties

Although five new varieties were approved for planting in 1960 no new ones were introduced to the approved lists for 1961. It is not possible, nor would it be particularly desirable, to have a large number of new varieties released each year. As and when better yielding varieties, or varieties

Inspecting a selection trial of rich land varieties at Meringa. The variety on extreme left is rich land standard, Q.66.

Varieties maintained growing in a horizontal position in a gravimorphic experiment.

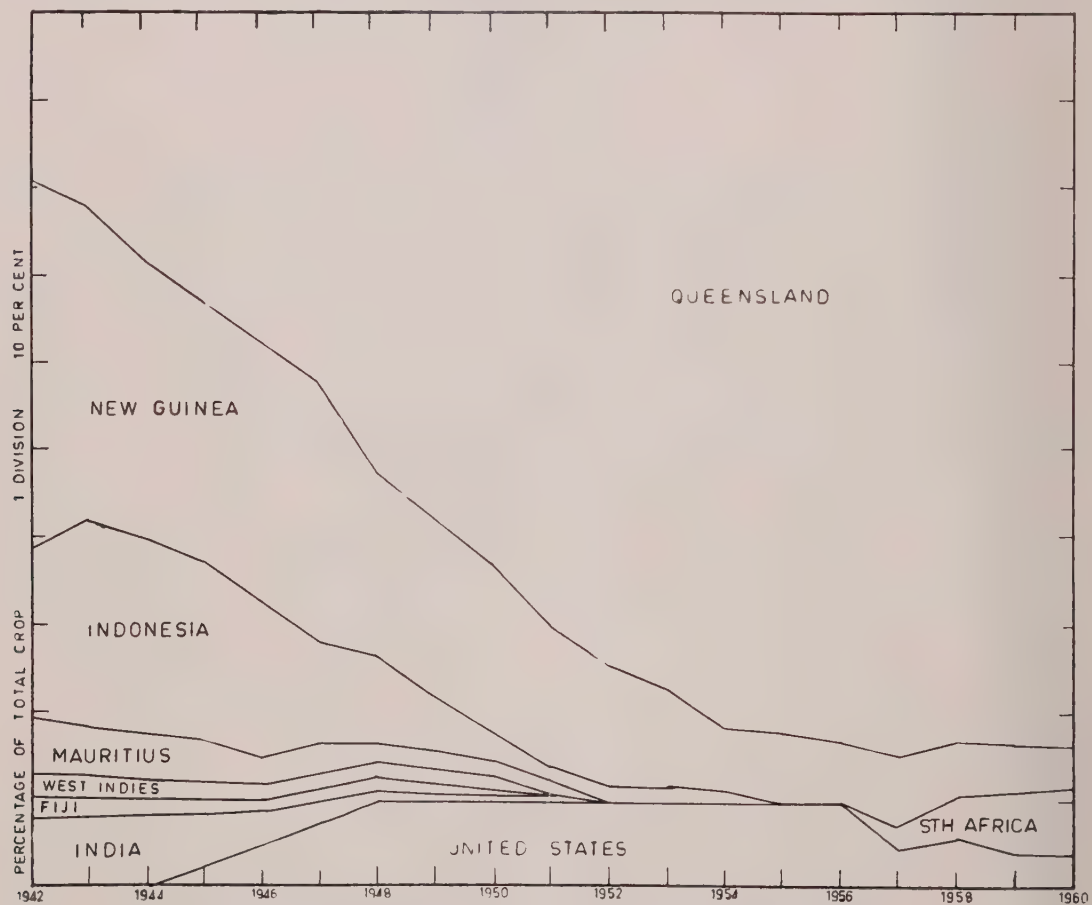
Photography is an important aid to extension work. Portion of the darkroom at Meringa.



which have specially valuable characteristics, are bred, they will be released to the industry. At the present time a "Q" number has been requested for 54N6441 which is a thin-stalked variety of high sugar content which is yielding well on the poorer soils of the far northern areas. L.74, a Bundaberg selection, is doing well on the Ingham Line and also merits a "Q" number, whilst 56A528, bred from Trojan and Q.28, shows some promise in the Burdekin. Following a large number of new approvals in recent years in the central district, no new canes are at present indicated for that area and there will be a good opportunity for growers to assess the value of recent releases such as Q.73. In the Bundaberg district the seedling showing greatest promise is 53S47, a variety bred from the cross 38S.N.4305 x Co.331. This seedling has excellent vigour and in small plots shows some promise also of standing over well. If this promise is consolidated the variety could be of great value to areas like the Isis where standover crops appear to provide a necessary insurance against severe droughts.

Table VII
Countries of Origin: 1960 Crop

Country of Origin	Tons of Cane	Per Cent
Queensland	7,318,302	84.3
South Africa	622,593	7.2
New Guinea	419,665	4.8
United States	292,701	3.4
Indonesia	21,957	.2
India	10,208	.1
	8,685,426	100.0



Composition of the Queensland crop on the basis of the country of origin.

Table VIII

1960 Season

Varietal Composition and Distribution in the Four Main Districts and in the State as a Whole—1960 Crop

Variety	North of Townsville		Burdekin and Giru		Proserpine and Mackay		Bundaberg and South		Whole State	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
1 Pindar	1,430,246	40.2	93,612	7.9	79,229	3.7	119,384	6.7	1,722,471	19.8
2 Q.50	135,928	3.8	24,298	2.0	795,709	36.7	317,322	17.9	1,273,257	14.7
3 Trojan	228,322	6.4	890,808	75.1	22,268	1.0	3,017	0.2	1,144,415	13.2
4 Q.57	799,733	22.5	63,814	5.4	31,617	1.5	123	—	895,287	10.3
5 Q.58	27,227	0.8	2,071	0.2	752,989	34.7	27,030	1.5	809,317	9.3
6 N.Co.310	—	—	—	—	135,329	6.2	487,264	27.5	622,593	7.2
7 Badila	397,872	11.2	20,348	1.7	1,445	—	—	—	419,665	4.8
8 CP29/116	—	—	—	—	3,549	0.2	289,152	16.3	292,701	3.4
9 Q.63	24	—	—	—	213,184	9.8	792	—	214,000	2.5
10 Vesta	—	—	—	—	—	—	174,729	9.9	174,729	2.0
11 Q.59	128,102	3.6	—	—	—	—	—	—	128,102	1.5
12 Vidar	108,435	3.0	—	—	—	—	—	—	108,435	1 2
13 Q.61	—	—	—	—	—	—	105,634	6.0	105,634	1.2
14 Q.70	—	—	—	—	—	—	85,410	4.8	85,410	1.0
15 Q.47	—	—	—	—	—	—	83,525	4.7	83,525	1.0
16 Q.68	—	—	—	—	75,290	3.5	—	—	75,290	0.9
17 Q.67	6,157	0.2	60,503	5.1	121	—	—	—	66,781	0.8
18 Q.44	55,445	1.6	—	—	—	—	—	—	55,445	0.6
19 Q.66	43,938	1.2	—	—	—	—	—	—	43,938	0.5
20 Q.55	—	—	—	—	—	—	33,811	1.9	33,811	0.4
21 Ragnar	32,415	0.9	—	—	—	—	—	—	32,415	0.4
22 Q.64	29,560	0.8	—	—	—	—	—	—	29,560	0.3
23 S.J.16	—	—	22,637	1.9	—	—	—	—	22,637	0.3
24 Q.65	—	—	—	—	21,084	1.0	—	—	21,084	0.2
25 POJ.2878	—	—	—	—	4,538	0.2	16,446	0.9	20,984	0.2
26 Q.73	—	—	—	—	19,519	0.9	—	—	19,519	0.2
27 Cadmus	19,261	0.5	—	—	—	—	—	—	19,261	0.2
28 Eros	15,449	0.4	—	—	—	—	—	—	15,449	0.2
29 Comus	13,588	0.4	922	0.1	62	—	—	—	14,572	0.2
30 Luna	13,023	0.4	—	—	—	—	—	—	13,023	0.1
31 Castor	12,207	0.3	—	—	—	—	—	—	12,207	0.1
32 S.J.4	11,273	0.3	—	—	—	—	—	—	11,273	0.1
33 Q.28	—	—	—	—	2,682	0.1	6,987	0.4	9,669	0.1
34 Co.475	9,441	0.3	—	—	—	—	—	—	9,441	0.1
35 Damon	8,443	0.2	—	—	—	—	—	—	8,443	0.1
36 Sirius	8,061	0.2	—	—	—	—	—	—	8,061	0.1
37 Q.51	—	—	—	—	—	—	6,021	0 3	6,021	0.1
38 Cato	4,784	0.1	—	—	—	—	—	—	4,784	0.1
39 Q.56	—	—	—	—	4,016	0.2	—	—	4,016	0.1
40 HQ.426	2,939	0.1	—	—	—	—	—	—	2,939	
41 Q.71	—	—	—	—	—	—	2,599	0.1	2,599	
42 Q.49	—	—	—	—	—	—	2,504	0.1	2,504	
43 E.K.28	—	—	973	0.1	—	—	—	—	973	
44 Q.62	—	—	—	—	—	—	938		938	0.1
45 Co.290	—	—	—	—	—	—	767		767	
46 Q.69	—	—	—	—	—	—	757	0.8	757	
47 Q.45	—	—	—	—	493	—	—		493	
48 Q.72	—	—	—	—	—	—	195		195	
49 Exp. & Others	16,250	0.6	5,442	0.5	6,933	0.3	7,411		36,036	0.4
	3,558,123	41.0	1,185,428	13.6	2,170,057	25.0	1,771,818	20.4	8,685,426	100.0

First ratoons of C.P.29-116 on left and Q.70 on right, harvested on the same day, showing tolerance and susceptibility respectively to furfuracca grub attack in the Isis district.

Division of Entomology and Pathology

R. W. Mungomery, Assistant to Director

The year 1960-61 under review was one of extremely harsh growing conditions, and was characterized by prolonged periods of dry weather throughout all the cane-growing areas of Queensland. In some districts the droughty conditions were interrupted for brief, irregular periods by inadequate falls of rain, which gave only temporary relief. Consequently, it became difficult in many cases to draw a sharp line of demarcation between losses that were caused primarily by pests and diseases on the one hand and by lack of soil moisture on the other.

There can be no doubt, however, that the adverse weather did accentuate the damage caused by certain pests and diseases, while in other instances the dry conditions actually favoured their development. This same factor was responsible for a general weakening of the parasite-predator complex which subsequently led to unbalanced insect populations and to a consequent upsurge in pest incidence.

Army-worms were a case in point where marked increases followed as a direct result of the comparative scarcity of natural enemies, and extensive infestations of two species, *Laphygma exempta* Walk, and *Pseudaletia unipuncta* Haw., occurred from December, 1960, to February, 1961, in most of the cane areas from Mossman to Mackay. These heavy infestations may also have been induced, in large measure, by the extent of grassy fields which quickly appeared after the first summer rains and which undoubtedly attracted large numbers of moths to lay their eggs there.

Another important pest to appear as a direct result of the dry conditions in the coastal fringe was the spur-throated locust, *Austracris guttulosa* Walk., which invaded the cane-growing areas of north and central Queensland from the adjacent pastoral country of York Peninsula.

Both of these pests caused considerable defoliation and, in consequence, aerial spraying of several thousand acres was adopted as a quick means of cleaning up these extensive infestations. The first of the season's aerial spraying was carried out against army-worms and, although this was generally successful, in some instances due to the late arrival of aircraft the campaigns were got under way too late to lessen the damage appreciably and to prevent the insects from completing their cycle. Fortunately, parasites were subsequently able to suppress any further wide-scale activities that might otherwise have resulted from a succeeding generation. However, the organization was at hand to control any similar outbreaks of leaf-eating pests. Consequently soon afterwards, when winged locusts began to appear in these areas, operations were quickly geared to an all-out offensive against the resulting bands of young hoppers when they hatched out and concentrated to feed in fields of young cane.

Damage caused by grubs of the greyback cane beetle, *Dermolepida albohirtum* Waterh., showed up

at widely separated points from Cairns in the north through to the Herbert River and Burdekin districts and to as far south as Carmila, the majority of the fields affected being those to which no BHC had been applied for some years. Although most of the damage was light and spotty, there was considerable uprooting of stools and extensive yellowing of foliage in the Cordelia area near Ingham, and these occurrences should serve as bitter reminders that the pest is present in sufficient numbers to inflict even heavier losses on next season's crops unless the fields are adequately protected by suitable insecticides. It is indeed unfortunate that the fruits of this negligent attitude towards grub control should have been brought home at a time when the industry is struggling to reach its allowable production quota; however, such costly experiences should not be forgotten quickly by the growers concerned.

A considerable increase in the spray application of lindane to over 3,000 acres of potential grub-infested fields took place last year in the Burdekin district, where, as an indication of the trend that is occurring there, 1,879 acres were treated in this manner in the Inkerman mill area as against 267 acres treated with the orthodox 20 per cent BHC dust. Increased interest in this method of application was manifested in some of the areas further north where a number of units were being operated, while in the southern districts modified boom sprays were being utilized for applying broadcast dressings of insecticides for the control of the soldier fly pest and various species of white grubs. In view of the fact that relatively heavy dressings are needed for the control of soldier fly and some species of two-year cycle cane grubs, the use of concentrated formulations of lindane and similar insecticides for spray applications has brought the cost of control well within economic limits, whereas the use of low percentage insecticidal dusts in equivalent quantities to achieve the same result would have rendered the cost prohibitive.

Some difficulties were experienced in maintaining a uniform suspension and application of some of the dispersible lindane powders but, in the best of the spray units in operation, the variations in rate of application were probably no greater than those experienced with many of the machines that were used for applying BHC dusts. Nevertheless, the performance of some home-made spray units left much to be desired and a small amount of the grub damage that occurred in the Burdekin area could be attributed directly to the insecticide being applied at far too light a rate because of poor agitation in these sub-standard spray units.

Considerable time was therefore spent in efforts to increase the efficiency of the better-class units, while more drastic alterations were suggested for those machines whose designs were obviously faulty. In attempting to overcome some of the difficulties associated with maintaining dispersible lindane powders in satisfactory suspension, close liaison was maintained with a number of firms which formulate various agricultural chemicals. As a side issue, a 60 per cent aldrin emulsifiable concentrate was evolved which, besides being easy to apply uniformly to the soil, gives promise of being comparable in price to lindane. This product which was wanted primarily for funnel ant (*Aphaenogaster* spp.) control, can also be used as an alternative to lindane for controlling grubs of the greyback cane beetle, and it may eventually prove equally satisfactory for controlling larvae of the soldier fly, *Metoponia rubriceps* Macq., and of *Rhyparida* spp.

A major break-through in the chemical control of the Childers cane grub, *Pseudholophylla furfuracea* Burm., was obtained when it was demonstrated by means of various experimental plots in the Isis district that broadcast treatments of lindane, ploughed under before planting, were effective against this pest. Crude BHC, which was equally effective in killing grubs, presumably had some retarding effect on cane growth during the dry weather experienced there, so lindane became the preferred insecticide on that account. At this stage a tentative application rate of approximately 6lb. per acre has been suggested as being effective over the normal cropping cycle of one plant and two ratoon crops, but no definite recommendations will be made until the full range of crops from current trials indicates the most economic rate of application. At the present time the residual effect of these insecticides seems to be satisfactory, and from grub counts made in trials ploughed out early in 1961 it was apparent that the original dressings of BHC

made two years previously were still exercising substantial control over grubs that had recently hatched. The prospects, therefore, are reasonably bright that a moderately heavy application of lindane will be able to effect control for the duration of the normal cropping cycle, and growers who have had consistent trouble from this pest in the past would be well advised to try this form of control in a modest way, setting aside small untreated areas for comparison purposes.

The control of *Rhopaea rugulosa* Blkb. in the Moreton area by similar methods also seems likely, but South Queensland growers should not lose sight of the important role played by tolerant varieties in with-standing grub attack and the effects of dry weather. In this respect C.P. 29-116 has proved a wonderful asset in the past, and it has by no means outlived its usefulness.

The problem of poor ratooning was again vigorously pursued and the usual pattern of slow, patchy ratoons in early harvested fields was again obvious in a number of South Queensland canefields where there was a considerable, if not complete, association of soldier fly larvae with this trouble.

Field trials in the Bundaberg area against this soldier fly pest yielded valuable data last season which revealed a staisfactory starting point for the ultimate control of this pest in cane-growing areas. In these trials, broadcast dressing of either lindane or aldrin, which had been incorporated in the soil at the rate of 8lb. per acre, produced well-grown ratoons in contrast to the poor ratoon crops which characterized the untreated areas. A yield difference of 20 tons per acre was recorded from one trial, while in other trials this year differences be-

Young ratoons in a soldier fly trial at Bundaberg showing 8 lb BHC plot in background and uneven control plot in foreground.

tween treated and untreated plots were estimated to range between 10 and 20 tons per acre.

Strange to say, comparatively low insecticide dressings (1-2 lb. of active ingredient per acre) in some of these trials allowed the survival of more soldier fly larvae and produced worse crops than was the case in the untreated controls. It is suspected that the sub-standard dressings of insecticide were insufficient to kill soldier fly larvae, but adequate to destroy the predators, so a selective killing action occurred which was actually beneficial to the pest. This aspect will have to be watched carefully in future lest an adverse pest situation is encouraged as a result of some of these practices.

Unfortunately the experimental programme was out of balance to the extent that it included a much greater number of trials involving disced-in treatments than plough-under treatments; hence most of the successful results were obtained with the former method of application. However, one trial which involved ploughed-under and disced-in treatments of lindane and of aldrin gave indications that the ploughed-under method of incorporating the insecticides in the soil was superior to the disced-in method. Accordingly several trials involving these two methods of application with different insecticides were subsequently established to determine the best treatment for the long-term control of this pest.

Meanwhile those growers who previously suffered the worst damage are no longer apprehensive over possible ratoon failures from soldier fly infestations, and several have tackled the problem with calm confidence, adopting the treatments which our experiments have revealed so far to be the most satisfactory. In this way over 240 acres were treated on a commercial scale in the Bundaberg area during the past year.

Rats were troublesome over extensive areas, and, although the damage was not intensive, it reached into parts of southern Queensland, which is somewhat unusual. The losses were assessed at 40,000 tons of cane, and of this amount over 10,000 tons occurred in the Mackay-Proserpine area. However, much of this latter loss was induced by poor farming practices, since most of the damaged cane was thin and poorly grown, and comprised unfertilized, neglected crops averaging 15 tons of cane or less per acre. Much of this cane had been grown with as little attention as possible, the growers concerned accepting the calculated risk that these crops might or might not be required to fulfil any above-peak allocations resulting from short-falls elsewhere. In sharp contrast, the stouter stalks of the well-cultivated crops on the same farms suffered little or no damage.

In most instances baiting with packeted thallium coated wheat halted the attack, but where this method of control did not prove entirely successful further investigations are afoot to ascertain what species are involved and what factors are governing a continuation of this trouble. This seems to be a necessary preliminary approach to the problem before further studies are commenced on some species whose biology has not yet been fully investigated.

Fortunately disease was not responsible for any obviously severe losses in the 1960 crop, but the position will have to be watched very carefully in the future if this happy state of affairs is to be maintained, since both leaf scald and ratoon stunting disease combined to pose threats by re-asserting themselves from time to time. The loss of several hundred tons of cane from leaf scald in the Mulgrave area demonstrated the potentiality of this disease for causing substantial damage in susceptible varieties, while occurrences of poor growth as a result of ratoon stunting disease were evident in different parts of the State.

One of the chief weaknesses that has to be faced in the control of leaf scald is the ability of this disease to mask itself over comparatively long periods, and it is often only when unfavourable environmental conditions are encountered that infected plants of certain varieties manifest typical symptoms of this disease. In this respect Q.63 is one of the worst of the present-day varieties to contend with for, when leaf scald was discovered in this variety in Bundaberg and Mackay in 1960, and all district officers were alerted to inspect crops of Q.63 originating from suspect sources, it was not until almost a year later that a number of leaf-scald diseased stools of this variety were found

Stool of cane at Childers with soil dug away to show grubs attacking roots.

in the Moreton area, despite previous intensive searching there.

It has long been suspected that some other varieties have been acting as symptomless carriers over the years and, while these varieties continue to be grown over fairly extensive areas the threat to any susceptible varieties has always to be reckoned with, even though these latter may be grown in limited amounts as special purpose canes, as is the case with Q.66.

Roguing of diseased stools, in order to reduce to a minimum the incidence of leaf scald in Q.66 growing under very fertile conditions, was undertaken in some of the wetter northern areas in an attempt to maintain reasonably healthy planting material on the farms concerned. However, it is too early yet to assess the value of these roguing campaigns, but judging by the manner in which the disease may manifest itself in circumscribed areas while cane from the same source may display no symptoms whatsoever in another part of the same field, there would appear to be little ground for assuming that most of the infected stools are destroyed in these roguing campaigns. Hence there can be no grounds for optimism that the disease can be held at a low level of infection unless the more orthodox policy of bringing in disease-free planting material from higher land is rigidly adhered to.

Unfortunately, no satisfactory means has yet been evolved to cure the disease, and while the masking of symptoms remains such a feature of the disease in some varieties, it will be apparent that it is difficult to recommend some sources of plants with any degree of assurance. The use of various chemicals and heat as curative treatments is being perservered with, but in the meantime the 3-hour hot water treatment at 50°C. appears to suppress the disease to a large extent, and stocks originating from apparently healthy cane undergoing repeated yearly treatments would appear to offer the safest sources of plants.

Luckily, major varieties such as Pindar, Q.50, N.Co.310 and C.P.29-116 are resistant to this disease and while they continue to occupy such a large percentage of the acreage under cane the position is not likely to deteriorate suddenly. The solution to the leaf scald problem remains in the development of an ever-increasing proportion of resistant varieties and to that end close liaison is being maintained with the plant-breeders. In the meantime, a determined attempt was made to destroy all known diseased blocks in central and southern Queensland, but unless the disease is quickly eradicated from these centres the increased propagation of Q.63 and Q.71 is likely to render the problem of control more difficult in the long run.

The changing varietal picture of greater susceptibility to ratoon stunting disease has done little towards inspiring confidence that any important headway is being made in the eradication of this disease. Possibly the most that can be claimed at this stage is that the disease is being held without the occurrence of serious losses. This can be readily understood when it is realized that the resistant Q.50 is now in second place to the susceptible Q.58 in central Queensland, while the resistant C.P.29-116 in south Queensland has yielded considerable

ground to N.Co.310 and other susceptible varieties. In fact in some mill areas, the percentage of susceptible varieties has risen to as high as 80 per cent and, with a few fields showing obvious effects of the disease, it is evident that a much greater effort will have to be made on the part of Cane Pest and Disease Control Boards in having larger quantities of cane hot-water treated, and on the part of growers in ensuring that a better standard of farm hygiene is maintained.

The quantities of cane hot-water treated by different Cane Pest and Disease Boards varied appreciably from mill area to mill area, but unless the initial quantity treated each year is sufficient to provide ample stocks for all planting requirements after two successive years of propagation and multiplication, the disease will have enroached too much into existing plant sources to allow any signiflcant headway being made. Accordingly, all Boards were requested to aim at a target which has been tentatively set at one ton of cane treated for every 50 acres of cane planted. This should provide sufficient margin to allow the discard of that minor number of fields which inevitably become contaminated from time to time in campaigns of this magnitude.

The diffiiculties of some growers in producing near to peak requirements and the reluctance on the part of other growers to sell planting material because of the fear in some instances that tonnages so sold are not always recognized in the determination of farm peaks, have complicated the task of many Boards in providing sufficient stocks of clean planting material, but improved facilities in many quarters for hot-water treating either stalks or setts, have stimulated a greater number of growers to get their cane regularly hot-water treated. However, the provision of clean planting material is in itself of little avail unless it goes hand in hand with an efficient system of farm hygiene, and since cane cutters and contract harvesters are not primarily concerned in maintaining crops in a disease-free condition, it devolves once again upon the grower to ensure that all cane knives and the blades of cutter-planters and harvesting machines are properly sterilized before operations are commenced on each block of cane. More publicity must be given to this important matter, for it is obvious that too little attention has been given in the past to this aspect of disease control which is equally important as, and much less costly than, the more spectacular method of providing clean seed by heat treatment. It is only when these two lines of approach to the problem are scrupulously observed that any real

Applying aldrin by boom spray for funnel ant control on a field scale. The land was subsequently ploughed to ensure dispersion of the insecticide throughout the soil mass.

progress towards eradication will be made.

It is gratifying to record the marked progress that was made against mosaic disease in the Mackay district, where an intensive campaign involving roguing and seed selection has been vigorously pursued for the last few years. The number of stools rogued there during the year was 794, which contrasted favourably with 2,439 and 12,779 for the two previous years. With the destruction of several badly diseased fields in the Booyal area and the systematic roguing of lightly infested fields, this centre of mosaic in South Queensland was rapidly being brought under effective control, but the problem is complicated by the presence there of considerable areas of *Sorghum verticilliflorum*, which is acting as host for both the vector and the disease. Elsewhere in the south the disease was being held at comparatively low levels.

Dwarf disease was also effectively reduced in the Mackay district where a few years previously it had unwittingly been spread over a limited environment in diseased planting material of the somewhat tolerant Q.68. The control of planting material, the roguing of lightly infested fields and the orderly destruction of fields carrying heavier infestations all brought about a marked improvement in the disease situation, and with the destruction of the last known diseased field after harvest in 1961, it is confidently expected that any serious threat from this disease will by then have disappeared.

Fiji disease lingered on in commercial plantings, two stools being destroyed on a farm in the Moreton district and 60 stools on a fairly isolated farm in the Beenleigh district. The standing-over of crops in previous years was largely responsible for the disease not being detected earlier at Beenleigh, but with the anticipated harvesting of all fields this year, the prospects for eradication are much brighter.

The twenty-third Annual Conference of Cane Pest and Disease Control Boards was held at Eimeo, near Mackay, on 10th April, 1961, and was attended by 49 delegates from 20 Boards, in addition to 14 Bureau officers and representatives from local Junior Farmers' Organizations. Satisfaction was expressed over recent legislation that had been enacted to provide the legal machinery for the more efficient control of the giant sensitive weed, and it was hoped that as a natural sequence to this legislation, quarantine areas would be declared without delay. Trials by Bureau officers indicated that, as an additional means of preventing spread, the medium-term sterilization of small seed-infested areas gave considerable promise of success. Testing of lindane spray units, trials against southern cane grubs, campaigns against army-worms and damage by coots were other matters discussed on the pest side, while basal stem rot, the production of leaf-scald resistant varieties and a variety of matters associated with ratoon stunting disease were subjects dealt with under the item of disease control.

Stools damaged by furfuracea grubs in foreground with good stools behind, illustrating the patchy nature of the attack.

Entomological Investigations

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Associated with
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The Greyback Grub, *Dermolepida albohirtum* Waterh.

Greyback beetles, observed under very harsh droughty conditions in red volcanic soils at Upper Mulgrave prior to emergence, were not weakened by their prolonged imprisonment, and considerable numbers flew there in early January when released by rain. Beetles were very numerous at Ayr, Home Hill and Innisfail in January, and the incidence of some grub damage in all central and northern mill areas indicates their survival and emergence after prolonged drought. Grub damage developed on a number of farms where BHC had not been applied, and in a few fields where inadequate application appeared to be the probable cause of poor control. The total loss estimated in the 1961 crop, 5,812 tons of cane on 1,543 affected acres was about equal to the loss of 5,400 tons on 1,435 acres reported in the previous year. Distributed as it was among all central and northern mill areas, the damage was not serious in any one district, but it may be very fortunate that in the district most affected, Ayr, in which the loss was 1,760 tons, BHC has been applied on 1,550 more acres than in the previous year.

Other Species of Cane Grubs

Frenchi beetles, *Lepidiota frenchi* Blkb., flew in considerable numbers in the Mulgrave area from 29th December, 1960, through the first week of January, 1961. Overlapping generations of grubs progeny of that and of the previous season's emergence, could be found in greater numbers than usual in grass land; their scarcity in consolidated cane areas, including control plots in field trials must be attributed to the suppression of cane field populations by persistent widespread use of BHC Damage by grubs other than *D. albohirtum* was recorded only in the Mossman, Ingham, Prosperpine and Mackay districts, and estimates of loss, totalling 1,306 tons of cane on 205 affected acres, were made under difficulty, and possibly incompletely, owing to the wilted condition of the crop at the relevant time. In the Hambledon area grubs of *Lepidiota consobrina* Gir. reduced the crop on eight acres by an estimated 55 tons. At Mossman, the one-year species resembling *L. consobrina,* referred to as "Mossman" grubs, caused light damage in ten acres of ratoon cane where 100 lb. of 20 per cent. BHC dust per acre had been applied on the plant crop, and a loss of 50 tons ensued. Minor damage

was done by Dynastid grubs; in deep sandy soil at Mossman, *Dipelicus optatus* Sharp, in June, attacked the roots of young plant cane, and was suspected of inflicting damage on older cane, and at Goondi the grub stage of the black beetle, *Metanastes vulgivagus* Olliff, attacked the roots and caused considerable distress in young plant cane.

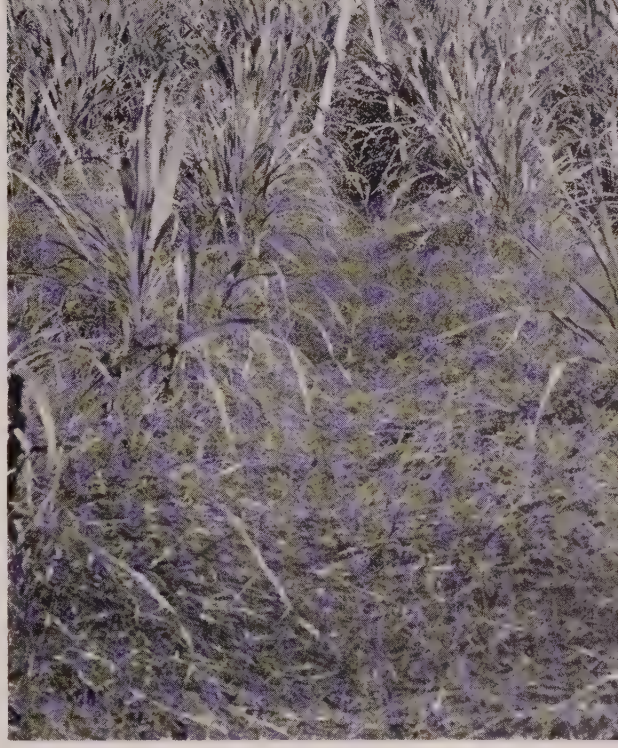
The Bundaberg grub, *Lepidiota trichosterna* Lea, and the Childers grub, *Pseudholophylla furfuracea* Burm., caused in their respective areas sporadic damage which has not been estimated. Grubs collected from below damaged cane at Didillibah in the Moreton Mill area were bred out, and identified as *Rhopaea rugulosa* Blkb.

Grubs which closely resemble *L. frenchi* were obtained from cane fields at Gooburrum, Pine Creek, and Elliott Heads in Bundaberg, Biggenden Road in the Isis area, Te Kowai and Marian in Mackay, and Gunyarra at Proserpine. The adults were bred from grubs collected at Gooburrum, and were also captured in the field there, and from eggs laid in cages by the latter, larvae were obtained. Presumed to be an undescribed species, the beetles are in the hands of a taxonomist.

Insecticides for Grub Control.

The 43,450 acres on which BHC was applied for grub control in the 1961 crop was 6,094 more than the 37,356 acres treated in the previous crop but was less than the 45,111 and 47,769 acres treated in 1959 and 1958 respectively. The above total included 4,600 acres on which lindane, used as a dispersible powder in water, was applied by spray as an alternative to the use, at greater cost, of BHC as a dust. That represented a substantial increase over the 1,200 acres treated with lindane in the previous crop, but whereas formerly the spray equipment purchased from commercial

Cane defoliated by day-feeding army-worms in Mulgrave, 1961.



A light application of 1lb aldrin per acre to the plot in the foreground has greatly accentuated soldier fly damage in comparison with similar first ratoon Q.70 in the untreated plot in the background. It is suspected that the light dressing killed the predators but did not affect the soldier fly larvae.

sources gave reasonably satisfactory application, the increased use of lindane was accompanied by the private construction of equipment which was ultimately shown to provide inferior uniformity of suspension and application. Investigations disclosed some of the reasons for the inferior performance. Enquiries for an aldrin formulation at minimum cost for the control of another pest, the funnel ant, disclosed an emulsion at a cost within the range of lindane; since its use would eliminate the difficulties of suspension associated with lindane, aldrin is likely to come into use for grub control where only the greyback species is involved, but BHC will continue to be necessary against other species, the susceptibility of which to aldrin is uncertain and is being investigated.

Where BHC was used against "Mossman" grubs (a species morphologically resembling *L. consobrina* but with a one-year life cycle) at the rate of 100 lb. of 2.6 per cent gamma BHC dust per acre in the plant crop, complete protection was not obtained in the subsequent first, or second, ratoons and field trials are being conducted into alternative rates and methods of application.

Experiments with Insecticides

In laboratory screening of insecticides against third-stage grubs of *L. trichosterna*, gamma BHC, aldrin, heptachlor, and telodrin were used at concentrations of 4, 8 and 16 parts of insecticide per million of air-dry soil, and sevin and trithion at 8 and 16 p.p.m. After 28 days exposure, during which time no deaths occurred amongst control grubs in untreated soil, the percentage mortalities in the individual insecticides were, in ascending order of concentrations in each instance: gamma BHC, 90, 100, 100; aldrin, 10, 20, 60; heptachlor, 40, 40, 60; telodrin, 90, 70, 90; sevin, 80, 90; trithion, 70, 100. In another test, against early third-stage frenchi grubs, telodrin was compared with gamma BHC at 4, 8 and 16 p.p.m. Mortality reached 100 per cent in BHC, in all three concentrations, in 39 days, but mortality in telodrin was less than in the untreated controls.

In an exploratory field trial against grubs of *Rhopaea rugulosa* Blkb., at Didillibah in the Moreton Mill area, aldrin and gamma BHC were broadcast and ploughed in at 2 lb. per acre, prior to planting, and applications of each insecticide at 4 lb. per acre were divided into broadcast applications of 2 lb. ploughed in, and the remaining 2 lb. disced in after ploughing. No grub infestation took place in the plant crop; in the first ratoons the numbers of second and third stage grubs found under randomly dug stools in each treatment area, and in adjacent areas, indicated that aldrin had not reduced the infestation, but BHC gave partial control at the lower rate, and no grubs were found where 4 lb. was applied.

In two randomised trials with BHC against grubs of *P. furfuracea*, poor ratooning in one and poor germination in the other led to the stools being ploughed out prematurely with only plant crop yield data being obtained, but the numbers of first and third stage grubs found in sampled areas

in untreated control plots and in plots treated at 4, 6, 8 and 10 lb. per acre with gamma BHC as lindane and at 4 and 8 lb. per acre as crude 20 per cent BHC dust, broadcast and ploughed in prior to planting, indicated that BHC can give control, by destroying a high proportion of the larvae at an early stage in their development; grubs which had reached the third instar before encountering the treatment were also substantially reduced in number. Observations on crop growth in another trial, recently installed, suggest that lindane at the 6 lb. rate may be minimal for the protection of the plant crop, and that crude BHC would be inferior because of some degree of phytotoxicity occurring during dry conditions which periodically prevail there.

In a field trial against "Mossman" grubs, near Port Douglas, the infestation in the plant crop averaged 4.8 grubs per stool sampled in untreated control plots, but despite a very dry season no symptoms of grub damage developed. The trial is being continued in the ratoon crops. In a trial comparing sprayed lindane with crude BHC dust for the control of frenchi grubs, there was an average of 2.7 third stage grubs per sampled stool in plots given sub-standard protection only, but the absence of visual growth differences makes it unlikely that crop yields will be informative. In the long-range investigation into whether BHC, either crude or refined, at the rates used for the control of northern grub species but not including the high rates being tested in the southern fields trials described above, may ultimately affect soil fertility, the harvesting of a second ratoon crop at Babinda and a plant crop in the Lower Buredkin supported the previous findings that the soil fertility has not been altered.

Hills raised by funnel ants in a heavily infested untreated plot.

The Funnel Ant, *Aphaenogaster pythia*, Forel

In a five-replicate field trial against the funnel ant at Tully, aldrin at 4 lb., and gamma BHC at 4 and 8 lb., per acre were broadcast and disced and ploughed in prior to planting, and compared with similar amounts of these insecticides applied as side dressings in the half-open drill five months after planting. Untreated control plots were maintained, and another treatment comprised a virtually ineffective surface application of a bait consisting of sugar solution and diazinon on a bran base. In the plant crop the mean treatment yields ranged only from 18.4 to 21.6 tons per acre (untreated, 19.2), with no significant differences. In the first ratoon crop the variety grown, Q.57, proved highly susceptible to damage by the ants. Only partial control was achieved by any treatment and patchy distribution of severe ratoon failure within treatments precluded statistical significance in the yield data. However, the results were considered informative. The untreated controls and the plots that were baited ineffectively gave mean yields of 13.4 and 12.3 tons per acre respectively. The broadcast method of application appeared superior to the side dressing, giving mean treatment yields of 19.7, 19.2 and 20.9 for the insecticides and rates in the order set out above, as against 15.5, 16.4 and 17.1 tons peracre obtained from the latter method. In adjoining exploratory plots on which aldrin had been broadcast and ploughed in at 20 lb. per acre, infestation was eliminated during the plant and first ratoon crops and the cane, estimated at 30 tons per acre, stood out in sharp contrast to the 13 ton crop surrounding it on untreated soil.

In a trial at Meerawa in which aldrin was applied at 5, 10 and 15 lb. per acre by three methods viz. (1) entirely broadcast and disced and ploughed in prior to planting, (2) divided equally between two broadcast applications one before and one after ploughing, the latter being subsequently disced in, and (3) entirely applied as a side dressing in the half-open drill five months after planting, no significant differences between treatment yields were found in the plant crop. Drought affected the first ratoons so badly that useful crop data would not be forthcoming. In the plant and first ratoon crops, while untreated control plots became heavily infested, infestation did not occur to any significant extent where 10 or 15 lb. of aldrin was applied by methods (1) and (2). Some infestation occurred where 5 lb. per acre was applied by any of the methods, and at all rates where used in method (3), but all treatments reduced the infestation in comparison with untreated plots. In another trial in which aldrin and heptachlor at 5, 10 and 15 lb. per acre, were broadcast in one application and ploughed in, minor infestation occurred in the plant crop where the two insecticides were used at the 5 lb. rate and untreated plots were moderately infested. However, there was no clear indication as to which is the more efficient of the two insecticides for this purpose. While further investigation is required to define the optimum treatment, it was considered opportune to make the benefits obtainable from these investigations available to growers in 1961, the interim recommendation issued being that aldrin be applied broadcast and ploughed in, at 12 lb. per acre, with discing of the application before ploughing to improve distribution through the soil. An area of three acres was treated accurately with aldrin at 12 lb. per acre, on which a quantitative trial will be conducted four years later to assess whether the full amount, or a lesser quantity, need be applied before subsequent plantings.

Soldier Fly, *Metoponia rubriceps*, Macquart

At Finch Hatton near Mackay, soldier fly larvae adversely affected the germination of cane on two farms in September. The numbers of adults captured in a single trap in that area indicated that the flies commenced to emerge in the second week of April, became most numerous during the first and second weeks of May, and decreased in numbers till none was found after the second week of June. In Bundaberg the emergence was more protracted, flies appearing as early as mid-March and as late as mid-July.

In field trials at Bundaberg either gamma BHC or aldrin at 8 lb. per acre, broadcast and cultivated into the soil prior to planting, gave excellent control of the larvae; timing the applications relative to adult emergence and oviposition appeared to be not so critical a factor as was earlier thought

Ratoon stools on right hand side depict well-grown cane in 8 lb BHC plots of soldier fly trial compared with poorly grown stools on left from adjacent untreated plots.

to be the case. Although 4 lb. of insecticide gave partial control in several instances, it appeared, on the basis of observations on growth and larval counts, that light applications of 1-2 lb. of insecticide per acre could accentuate damage, presumably by reducing the predaceous fauna, to the benefit of the pest. In various trials the insecticides were either ploughed in or disced in; further work is being done to determine the most effective insecticide and the optimum method and rate of application.

While circumstances arising out of overproduction prevented complete crop yield data being obtained, first ratoon yields of 8 and 28 tons per acre respectively from an untreated control plot and an adjoining plot treated with BHC at the 8 lb. rate fairly represent the severity of the damage done by the pest and the benefit obtainable from chemical control.

Miscellaneous Insect Pests.

Heavy infestations of the day-feeding armyworm, *Laphygma exempta* Walk., appeared in the last week of December, on many farms in the Mossman, Hambledon, Mulgrave and Babinda areas and to a lesser extent at Innisfail and Tully. After hatching in grassy areas, the larvae were generally promptly controlled by DDT spray or BHC dust before they penetrated far into cane, but severe defoliation occurred in a few instances where control measures were applied too late or not at all. Parasitism by Tachinids was negligible in the initial stages but developed rapidly, and although the feeding period of the army-worms was not curtailed, mortality in the pupal stage prevented any serious outbreak, but there were minor, heavily parasitised, recurrences in early February. Much more extensive and damaging were the infestations of the night-feeding species, *Pseudaletia unipuncta* Haw., which commenced late in January in the Mackay and Ingham districts, affecting about 10,000 acres in each. Unless a close check is kept for the presence of this species, it is often difficult to apply control measures in time to prevent any substantial proportion of the potential damage from developing. Aerial spraying of insecticides, chiefly DDT, on 1,000 acres in Mackay from 7th to 11th February was almost certainly too late to be of benefit. A further 2,000 acres were estimated to have been treated there with ground equipment. Control measures specifically against this pest at Ingham involved aerial spraying of over 3,000 acres.

In December adults of the spur-throated locust, *Austracris guttulosa* Walk., were numerous on grassy headlands from Mossman to Ingham, having migrated into the coastal belt from their native habitat in the drier western plains. Their progeny were detected as first and second stage nymphs in the first week of February, and progressive hatchings quickly infested thousands of acres, chiefly grass and legumes on fallow ground, from which they migrated to cane; the degree of defoliation varied widely from field to field. A three-fold effect was anticipated viz. direct damaging effect of defoliation on crop growth, interfering and competitive weed growth, and increased harvesting costs. Chemical control of the nymphs, the maximum cost of which by aerial spraying

would approximate the value of half-a-ton of cane per acre, was considered warranted. It was estimated that 25,000 to 30,000 acres were infested by these pests and most of this was aerially sprayed. Aldrin at four ounces per acre proved effective, at little cost, but BHC was applied on a fairly wide scale, as a spray and as dust, to minimise the risk of toxicity to native fauna and domestic animals. However, at three and a half and seven ounces of gamma BHC per acre the degree of control varied considerably. In practice, dieldrin was most widely used because of the supply position, and gave excellent control at five ounces per acre. Where control measures were not instituted, the hoppers matured to the adult stage during April and frequented their sites of origin for some weeks, but decreased to negligible numbers by mid-July.

The damage done to ratoon shoots by larvae of *Rhyparida dimidiata* Baly and *R. morosa* Jac. at Bundaberg, Mackay and Proserpine during December and January was accentuated by drought. In six badly damaged stools examined at North Eton on 6th January were found a total of 14 larvae, 27 pupae and 22 adults, while six apparently undamaged but otherwise comparable stools contained nine larvae, four pupae and six adults. On the 21st January adults of *R. dimidiata* were numerous on eucalypt trees in that vicinity and the soil population was negligible. Adults emerged in large numbers on one site in Bundaberg as early as October. Wireworms, larvae of *Lacon variabilis* Cand., were generally controlled by BHC mixed with the fertilizer applied at planting time, but where that measure was omitted setts were attacked on approximately 330 acres at Proserpine, Mackay and Plane Creek, a 32-acre planting on virgin land becoming a total failure in one instance. Minor infestations occurred in other districts. Adults of the black beetle, *Metanastes vulgivagus* Olliff, were quite unusually prevalent in Hambledon, Mulgrave and Babinda in June, 1961, affecting several hundreds of acres, but side shoots quickly replaced the primaries killed by the beetles and the effect on the crop was negligible. Lindane, in fertilizer applied at planting, at 3½ oz. per acre was insufficient to control the beetles. In November larvae attacked the roots of young plant cane, causing added distress in dry conditions. The giant termite, *Mastotermes darwiniensis* Froggatt, did minor damage in the Burdekin area; neither aldrin nor lindane at one pound per acre, sprayed on the soil below, and over the setts at planting time gave appreciable control. *Rhinotermes intermedius seclusus* Hill accelerated the effects of drought on five months' old plant cane on red volcanic soil in Mulgrave, and destroyed germinating setts in patches in similar soil at Bartle Frere. *Coptotermes acinaciformis* Froggatt damaged germinating cane at Pinnacle in the Mackay district. The scale insect, *Aulacaspis madiunensis* Zehnt., affected standover crops in the Isis area in an unprecedented degree in 1961, some fields of the more susceptible varieties having the millable cane entirely covered with the insects. A promising new variety under test, 53S47, combined excellent physical standover characteristics with a high degree of resistance to the scale. The Drosophilid, *Gitona perspicax* Knab, was recorded as a predator on the pink sugar cane mealybug, *Saccharicoccus sacchari* Ckll., at Mossman, Mackay and Bundaberg.

Animal and Bird Pests

The loss of cane caused by rat activity in the 1960 crop was estimated at over 40,000 tons, almost

Insect trap of the type used to detect soldier fly emergences.

double the 21,000 loss estimated in the previous year. Rats were particularly active throughout the Mackay and Proserpine districts during August, and these areas, with Ingham and Tully, suffered the greatest damage. At the commencement of the 1961 harvest the reports received from different districts on rat activity varied widely, from negligible to considerable, and there was an increased demand for poison bait where rats were most active. In some mill areas local pest control officers experimented with warfarin and endrin as rat poisons, but without reaching any conclusions on whether or not these poisons might be superior to the thallium sulphate or phosphorus in general use. Wallabies, deprived of their natural food by drought, damaged cane on 225 acres in the Mackay, Proserpine and Plane Creek districts, causing losses estimated at several hundreds of tons, but their activities at Ayr on a wider scale caused losses estimated at 1,700 tons, one field of 13 acres being a total loss. The application of blood and bone on the foliage at one hundredweight per acre was again proved a successful repellent in the Mulgrave area. Poisoning the foliage with strychnine met with variable results. Pigs destroyed a few hundreds of tons of cane, being most in evidence at Babinda and Mossman but the extension of existing fences in the former locality is expected to reduce the damage in the future. The striped phalanger did minor damage in northern areas to cane near rain forest. Bird pests comprised the bald coot, the white cockatoo and the shiny starling. The first-named was particularly troublesome at Mackay and Proserpine, damaging both young and mature cane, 68 acres being affected. White cockatoos were less troublesome at Proserpine than in some previous years, causing loss estimated at 80 tons on four acres. Shiny starlings damaged cane at South Johnstone by perching in such numbers as to destroy the foliage.

Serious losses due to leaf scald in first ratoon Q.64 on a dry hillside in North Queensland.

Disease Investigations

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Chlorotic Streak (Probable virus)

Yield trials with chlorotic streak diseased and healthy cane were harvested in the very wet (180 inches plus) Mt. Sophia-Deeral area and at Mackay. The plant trial at Deeral, which included Pindar, Q.66 and Q.67, gave the yields of cane set out in the table when cut in August, 1960. The differences for Pindar were significant at the one per cent level and for Q.67 at the five; those for Q.66 were not significant. Since c.c.s. figures were not significant for any variety, the sugar yield figures were of the same order of significance as the cane tonnages.

The ratoons of the yield loss trial with Q.66 at Mt. Sophia showed a heavy infection of the disease in all plots and, although the tonnage differences in the plant crop had been significant, the lack of significance in the ratoons was not unexpected. The difficulty of conducting trials in the wet areas where, for instance, both chlorotic streak and leaf scald are endemic, is highlighted by the development of so much leaf scald in the trial that further ratoons will have to be abandoned.

The first ratoons of the trial at Dumbleton, Mackay, yielded so poorly (as shown in the table) that, although differences in yields of healthy and

Chlorotic Streak Yield Trial Results, Tons per Acre.

Deeral Trial	Pindar	Q.66	Q.67
Healthy	46.0	34.9	32.8
Diseased	32.9	28.9	24.0
Difference	**	N.S.	*

Dumbleton Trial	N.Co.310		Q.50		Q.56		Q.63	
	Plant	Ratoon	Plant	Ratoon	Plant	Ratoon	Plant	Ratoon
Healthy	32.3	26.1	30.5	17.1	27.8	14.8	28.7	14.1
Diseased	28.2	22.8	26.1	15.3	23.0	9.8	22.8	12.6
Difference	N.S.	*	**	N.S.	**	**	**	N.S.

N.S.: not significant. ** significant at 1 per cent. level. * significant at 5 per cent. level.

Constant temperature baths used in the chlorotic streak work in the Brisbane glasshouse.

diseased N.Co.310 and Q.56 were significant, the results from this crop should be largely discounted.

Investigations on chlorotic streak at the Northern Sugar Experiment Station in a shelter-shed with a plastic roof, and at Brisbane in glasshouses, were concerned with the transmission of the disease, the size of the causal organism and an alternate host.

Extracts of diseased cane plants were prepared by the maceration of streaked leaves, the pressure extraction of stalk juices or the mincing of roots taken from solution cultures. Inoculations were made into the roots of healthy plants either directly by means of a fine hypodermic needle or by immersion of the intact root system for seven days in the extract diluted 1 in 20 with nutrient solution. Inoculated plants were transferred to individual gravel-nutrient solution cultures and maintained in the glasshouse with an adequate number of controls treated with extracts from healthy plants. Transmission of chlorotic streak was obtained with each method of inoculation but only with the extract from diseased roots, indicating that the roots could be the site of greatest concentration of the causal agent.

Direct transmission, per medium of the soil, was obtained by planting alternate rows of healthy and diseased material in furrows within a glasshouse and filling in the furrows with soil collected in the field from the base of stools showing obvious symptoms of the disease. The glasshouse was flooded at intervals to produce the water-logging characteristic of fields where the disease occurs naturally. Over a period of almost two years, during which the cane was ratooned, 16 per cent of the originally healthy stools had shown symptoms by the winter of 1960, when all stools were dug out and as much debris as possible removed by forking. After a lapse of 47 days, healthy setts of the variety N.Co.310 were planted and, after the primary shoots had come away, the ground was flooded every day except on the weekends. All shoots were ratooned 25 weeks after planting. A number of transmissions, approximating six per cent of the stools, showed during the following months and it is apparent that the disease may be carried over in the soil—for at least a period of 47 days—from one planting to the next in the absence of host plants.

Experiments at the Northern Station using gravel cultures in painted, galvanized-iron troughs, holding 30-40 shoots each, gave results of considerable interest. One experiment with these troughs containing healthy and diseased plants in which one third of the total healthy shoots was not ratooned, one third ratooned at nine weeks and one third at 14 weeks gave the following percentage infections:—

Days after planting	100	125	175	225
Not ratocned	—	22	50	83
Ratooned at 63 days	—	63	88	94
Ratooned at 98 days	—	6	94	100

It would appear that the main function of ratooning is to accelerate the appearance of symptoms in stools already diseased, although it

is possible that ratooning in itself may have an effect on transmission.

The effect of ratooning was further investigated in two other similar trough experiments. In one, three diseased stools were planted into a trough at the same time as the 33 established, healthy stools were ratooned. Infection showed in the remarkably short time of 21 days and when the trough was abandoned at 56 days, nine (27 per cent) stools had developed symptoms. In the second experiment, which is not yet completed, the first transmission again showed at 21 days after the introduction of the diseased plants; by 56 days 88 per cent of the stools ratooned at the same time as the diseased plants were introduced had shown the disease, but less than ten per cent in those ratooned 25 days before or 28 days afterwards.

Water from infected sources was apparently the agent of transmission in three experiments. In two, ditch water collected from fields where chlorotic streak was present, was used; in the other, drainage water from troughs carrying diseased plants. Ditch water collected from 26th April to 12th August, 1960, *i.e.* over the drier autumn-winter period, was added to healthy cane in troughs and ten per cent transmission was obtained within a period of eight months from the first addition. Transmission was also obtained when the ditch water was added during the summer and autumn months. Drainage water from diseased troughs was stored for 0, 3½, 7 and 14 days before being added over a period of 13 to 20 weeks to healthy shoots growing in gravel in two-gallon containers. The experiment was in progress for ten months.

Uneven growth and losses in Pindar in North Queensland due to ratoon stunting disease and dry weather.

The antibiotic streptomycin tested as a possible aid in the control of leaf-scald disease produced much chlorosis. Untreated in right foreground.

Results are shown below as a percentage of containers diseased.

Storage time days	0	3½	7	14
At 5 months	88	12	12	0
At 10 months	100	50	100	0

The storage for 14 days led to the production of hydrogen sulphide and it is possible that the high reduction potential had an adverse effect on the longevity of the causal agent. Concurrently with this experiment, two other experiments were set out in which healthy shoots were planted into gravel from other troughs which had contained a high percentage of diseased stools. As much root debris as possible had been removed and the gravel left covered with water for three days before the shoots were added. One experiment showed 35 per cent diseased shoots within four months, the other 79 per cent within approximately the same time.

In another type of experiment (in Brisbane) healthy plants were placed in association with diseased plants, either in aerated nutrient solution or nutrient gravel, for periods of seven to 12 days, then transferred to individual gravel cultures. Infection did not occur in four groups (the reason for which was not clear) but, in the four groups where it did, it ranged from 40 to 70 per cent. The incubation period varied between 72 and 308 days, indicating a much longer period under glass in Brisbane than in the shed at the Northern Station.

Insects and mites often build up alarmingly in cultural work with sugar cane under cover and it was pleasing to find in connection with the studies on chlorotic streak that the disease would transmit and that the plants suffered little if any damage, when the systemic compound Metasystox

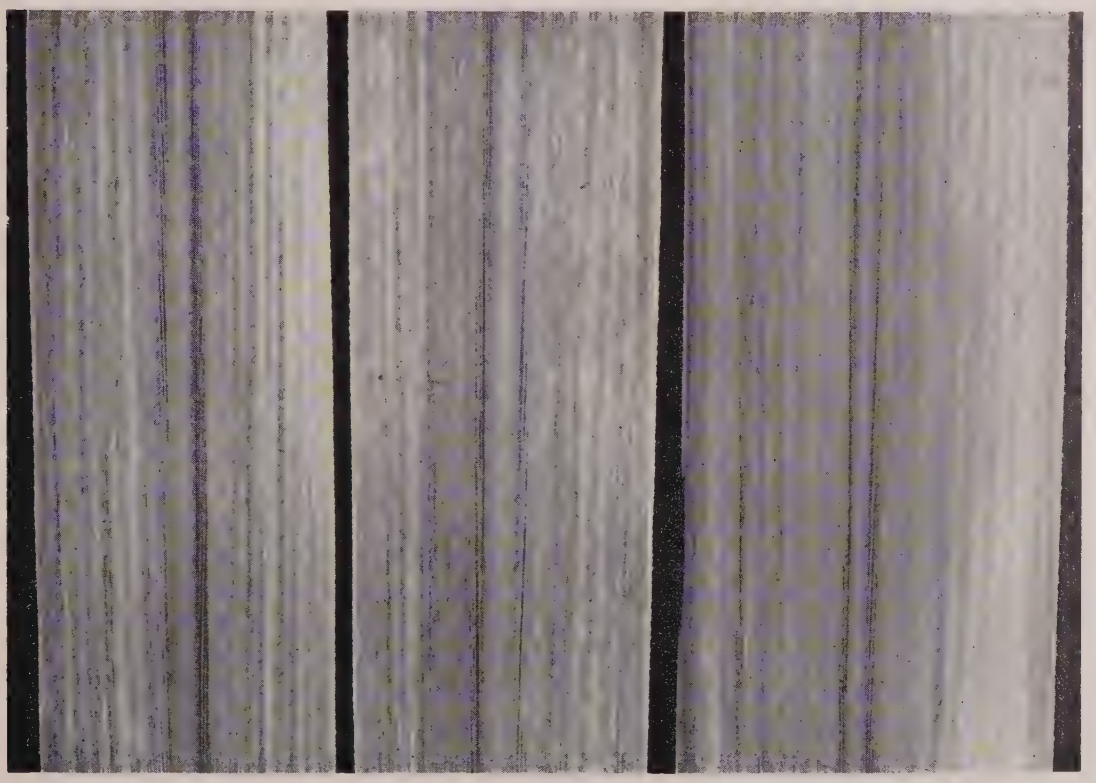
was used for their control. In aerated solutions a spray (0.025 per cent active principle) proved effective; in gravel culture the Metasystox was added to the troughs to give 40 parts per million of active ingredient every two to three weeks. It was added at the solution change and was not removed until the next change a week later.

The percentage transmission obtained with diluted root extract was sufficiently high to warrant the application of a root inoculation technique in determining the approximate size of the causal agent. Extracts were filtered in series through sintered glass and standard bacteriological filter discs. Filtrates were diluted 1 in 20 with nutrient solution and roots of the test plants immersed for up to eight days. Transmissions were obtained with all filtrates down to the finest used —a pad (Ekwip D9) with an initial retention of all particles of less than 0.5 micron.

Gravel-trough cultures containing (*a*) seedlings of elephant grass, *Pennisetum purpureum* Schum., and diseased shoots of cane, (*b*) elephant grass (originally from streaked material growing wild at Mossman, North Queensland) showing streaks, and healthy cane shoots and (*c*) elephant grass seedlings and healthy cane plants, were set up in May, 1960, in the glasshouse at Brisbane. Transmissions occurred from cane to grass and grass to cane, thus demonstrating that the disease in the elephant grass was chlorotic streak and that it could be transmitted to cane, while diseased cane could also infect the grass.

Ratoon Stunting Disease (Virus)

The ratoons of the ratoon stunting disease resistance trial at the Pathology Farm were deliberately not watered during the year and the harsh conditions resulted in one of the poorest



The striations of striate mosaic are just discernible to the naked eye. Healthy leaf on right.

Red-stripe disease is serious in young ratoons of the susceptible Q.67. The smallest shoot is dead.

crops since the Farm was established in 1952. The best plots did not yield more than 20 tons per acre and the differences between diseased and healthy plots were accentuated. The diseased plots in some of the more sensitive varieties produced less than one foot of cane, often yielding as little as 10 to 30 per cent of the healthy. It was noted that some of the seedlings, for the first time on record, suffered more severely than Q.28, and losses in Q.50 were much higher than is usual in either trial or field. Under such conditions it was expected that the internal symptoms in the mature cane would be very obvious but such was not the case and, even in Q.28—the standard for good symptom development—the discoloured bundles were not conspicuous. The trial consisted mostly of seedlings; of the named varieties, the comparative resistance to loss of Q.55, Q.69, Q.72 and Cadmus, and the extreme sensitivity of Q.73, was confirmed.

Some 16 "Q" varieties have been named during the past decade and, since many of them are now bulking largely in the commercial crops of the State, their reactions to ratoon stunting disease are of general interest. Not one is of sufficient resistance to justify cultivation without precautions against the disease; Q.57, Q.59 and Q.68, and probably Q.56, Q.65, Q.69 and Q.72, are in the same class as the well-established Q.50 in that serious losses occur in them only in unusual circumstances; minor losses are more frequent. Q.58, Q.61, Q.63, Q.64, Q.66, Q.67 and Q.70 are much more likely to suffer serious crop losses, while Q.71 and Q.73 are as susceptible as Q.28, and their cultivation when diseased can be disastrous.

Fiji Disease (Virus)

The forecast made in this Report for 1959-60 that, although Fiji disease was not found during the summer of 1960, the disease could still be present in Moreton and Rocky Point areas has, in the event, proved correct. Two stools only were found at Moreton in a block which had been the source of plants for the field found diseased in February, 1959, but in which Fiji could not then be found. The finding of 60 stools in a block at Eagleby (Rocky Point) was in ratoons from a standover block which had been too dense for adequate inspection during the summer of 1960.

The Fiji disease resistance trial at the Pathology Farm was stood over in the plant crop and showed a satisfactory amount of disease in the ratoons. The threat which the standing over of a Fiji trial presents to other plantings at the Farm is demonstrated by the fact that approximately 40 stools were rogued from these during the course

of this trial. Percentage infection in the trial varied from 0 to 35 in the seedlings under test while Q.55 showed 14 per cent, Q.67, 0 and N.Co.310, 11. Figures for the standard, reference varieties were C.P.29-116, 20, H.32-8560, 95, M.1900S., 87 and P.O.J.2878, 90.

Leaf Scald

Xanthomonas albilineans (**Ashby**) **Dowson**

The outbreaks of leaf-scald disease in the Mackay, Bundaberg and Childers districts, which were found in the autumn of 1960 after a lapse of many years, were the subject of vigorous control measures. The majority of infected blocks were ploughed out after harvest and those allowed to remain were consistently rogued until well into the following crop. It would appear that the outbreaks have been contained and that the virtual elimination of the diseased stands of Q.63 has prevented any further development in these districts. Conditions during the growing period of the 1961 crop were less favourable than normal in all three areas and it is considered that masking of the disease was not on a wide scale. It will be some years before these outbreaks can be viewed in proper perspective but it is felt that further commercial losses will be of a much smaller nature. A feature in the fields awaiting harvest and destruction in the very dry spring of 1960 was the development, to a marked degree, of the acute stage of the disease. This is characterised by a sudden wilting and death of the stalk, usually in the absence of any specific symptoms, and in some fields up to one per cent of the total stools were involved.

At Proserpine, further findings of leaf scald since the harvest season of 1960 have complicated the position and control measures will be intensified.

Little is known of the mechanism of the death due to the acute stage, nor was it known even whether the organism was distributed throughout the affected stalk. The opportunity was therefore taken to make isolations from the basal, middle and top portions of a number of stalks at the earliest discernible stage of wilt. Results showed that the bacteria were present in all stalks in decreasing numbers from the base upwards.

A small outbreak of leaf scald on two farms in the Moreton area during the autumn of 1961 is not regarded as being a serious threat. The disease was last found in the area in 1952 when it occurred only as a slight infection. The present four leading varieties, N.Co.310, Pindar, Q.50 and Q.61, comprising 86 per cent of the crop, are commercially resistant to the disease and there are no very susceptible varieties amongst the minor, promising canes. The diseased stools were found in Q.63.

Striate mosiac—a new disease of sugar cane—causes severe losses in Pindar (left) and Q.57 (right).

Irregularity in growth is characteristic of the miscellaneous diseases section at the Pathology Farm.

Leaf scald was also found on the Northern Experiment Station after many years, but even though the disease is endemic in the locality, the early elimination of the disease from the Station is anticipated.

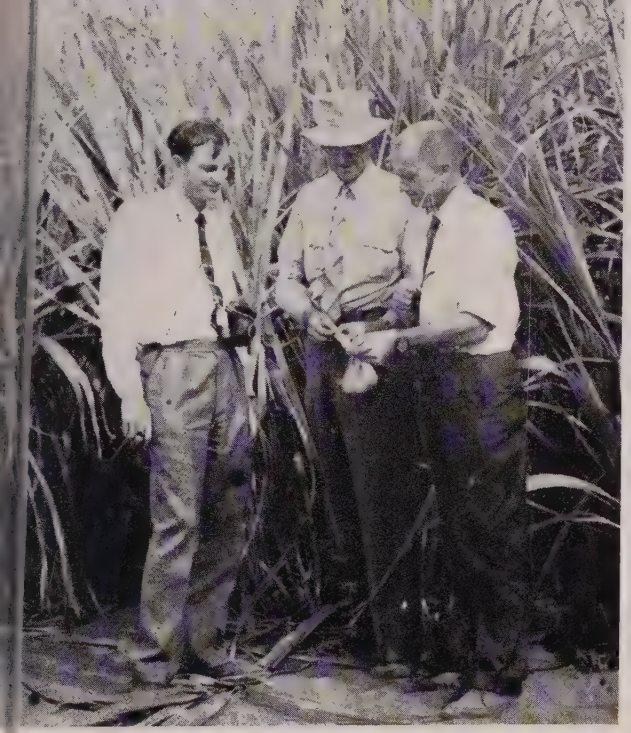
On the basis than an antibiotic incorporated in the hot-water treatment might allow complete control of the disease in setts—it is not eliminated by the standard hot-water at 50°C for three hours —13 antibiotics and three nitrofurans were tested against the organism *in vitro*. Streptomycin was the most effective in inhibiting growth and, in a field trial, setts were soaked for 16 or 24 hours in streptomycin solutions at strengths ranging from .01 to .2 per cent, in combination with hot-air and hot-water treatments.

This skirmish trial has not yet been finalized but it is already obvious that this antibiotic could not be used in treating diseased setts owing to the damage to the resultant shoots. This ranged from a complete albinism, which was so severe as to kill the shoots, to a temporary chlorotic variegation. It was thus impossible to pick out streaks of leaf scald on these shoots with any degree of certainty. The fact that every treatment showed some scald also indicated that streptomycin would be useless.

The leaf-scald resistance trial planted at the Pathology Farm in 1958, and inoculated at ratooning in 1959, developed a satisfactory amount of disease during the growing period (which was noted in this Report for last year, pp. 85-86). In the dry winter and spring of 1960, however, a great deal of death developed from both the acute and chronic stages. Plots of Q.64 and a seedling L.688, were killed completely but the extra deaths throughout the trial did not cause any revision of the resistance ratings previously given.

The trial at the Farm, ratooned in 1960, developed a satisfactory amount of disease although the acute stage has not yet shown. The varieties B.3337, Cadmus, M.147/44, Pindar, Q.55, Q.68, Q.69, Q.70 and Q.73, and the seedlings L.46 and 54C.241, showed adequate resistance: Q.44 and Q.66, and seedlings, L.622 and M.98, were very susceptible, while B.37172, Damon, E.1/37, Q.62, Q.65, Q.71, Q.72, 53A.434, L.74 and N.659, showed a degree of masking similar to the Q.57 and Trojan, which made difficult any forecast as to their field resistance.

The large leaf-scald resistance trial on an abandoned cane farm at Myola on the edge of the tableland above Cairns grew reasonably well after ratooning and inoculating in August, 1960, despite the dry season and some trouble with grasshoppers. The majority of the 89 varieties included were advanced Bureau seedlings: there were also eight standards of known reaction to the disease, and a group of canes from overseas. The final inspections have not yet been made but it would appear that, of the named varieties under test, B.3337, B.4362, B.47419, H.39-3633, M.147/44 and Q.68 are reasonably resistant, while B.3439, B.37172 and E.1/37 are susceptible. The reactions of the varieties repeated in this trial agree with those obtained at the Pathology Farm.



Dr. D. H. Goodchild, Canberra (left), and Dr. John T. Slykhuis, Canada (right), discuss sugar-cane diseases with Mr. C. G. Hughes.

Striate Mosaic (Virus)

A series of experiments, which have been going on at the Pathology Farm for several years, culminated in proof during the year under review that a condition causing poor yields in Pindar and Q.57 in the Lower Burdekin district was definitely a new disease of sugar cane. The disease is sett-transmitted, but transmission was also obtained by the Sein inoculation method, *i.e.*, a needle-pricking through a diseased leaf into the rolled leaves of the young, rapidly growing spindle. It would appear that two viruses are involved, one of which produces the severe stunting, the other the characteristic fine striations on the younger leaves. The name "striate mosaic of sugar cane" is proposed for the disease although it is not suggested at this stage that the disease has any connection with the striate mosaic which has been recorded in some other grasses. Striate mosaic spreads very slowly in the field and its control presents no problem; it is possible, however, that the situation could change if the disease developed in more easily infected varieties. A search has been made for the disease in other districts without success. Short notes on the disease have been published in overseas journals and a Technical Communication is to be prepared.

Top Rot and Red Stripe

The top-rot form of this disease normally occurs in every field of susceptible varieties grown in the tropical districts of the State, although the economic effect varies widely from year to year. Serious losses in the variety Q.67, for instance, may occur on individual farms from time to time. However, Pindar, Q.57 and Trojan, are comparatively resistant and losses in these are very rare. It was of interest therefore that Trojan, in several fields on the Burdekin, showed heavy infections of up to 30 per cent over small areas in the summer of 1961. The form the disease took was abnormal in that death of the growing point occurred comparatively late in the season; the first external expression was a collapse and an unusual retting of the mature internodes and, since the vascular bundles were still largely intact, the above-infection parts of the plant stayed alive for a considerable time and, even by winter-time—four to five months later—the top was often still normal.

Bacterial Mottle

Pectobacterium carotovorum var. *graminarum* Dowson and Hayward

The idea that bacterial mottle is primarily a disease of local grasses, which provide the reservoir of inoculum for infection of the cane crop, was further reinforced by a finding of the disease in elephant (*Pennisetum purpureum* Schum.), Guinea (*Panicum maximum* Jacq.) and para (*Brachiaria mutica* Stapf.) grasses near Cairns in the higher reaches of Freshwater Creek, above cane and against virgin rain forest.

In the Ingham area, the spread of the disease in consistently mown Guinea grass was observed in areas which are not liable to flooding. The cutting blades of the mowing machine may have

been responsible and, since the mowing of farm headlands and roads is a practice which is increasing greatly, there is the possibility of a significant increase in the disease in both grasses and cane.

Bacterial mottle was recorded for the first time in the Tully area; it was in Q.66 and Q.67.

Miscellaneous Diseases

The light wet season of 1961, following upon the prolonged dry period during the latter half of 1960, precluded any build-up of yellow spot (*Cercospora koepkei* Kruger) and the disease was at its lowest ebb for many years. Many known susceptible varieties failed to develop the disease, and any experimental work was obviously impossible.

A basal stem and root rot which was described in this Report for last year, was more prominent than in previous years and severely-affected fields were noted in all mill areas from the Burdekin northwards except in the Innisfail district. It also occurred in some of the central and southern areas. Q.63, Q.67 and Trojan were the varieties chiefly affected. The causal organism, which is a basidiomycete, has resisted efforts to make it fructify and it remains unidentified.

An unidentified phycomycete made its appearance in bunch-planted seedlings in pots at the Northern Station. No risks were taken with this dangerous fungus and all infected pots were promptly destroyed. A period of continued, damp, cloudy weather may have been responsible for its development and a subsequent fine spell probably aided in its control.

Quarantine House

Distributions of setts from the Quarantine House in spring, 1961, to the Bureau Experiment Stations, Pathology Farm or the Colonial Sugar Refining Company, included the following:—

B.34104, B.39246, B.42231, B.4373, B.45137, B.47312, Co.349, Co.440, Co.449, Co.527, Co.L.9, Co.S.109, D.109, N.50/211, P.B.52-1-1, P.T.43-52, R.337, S.E.S.106B, S.E.S.205A, S.E.S.351, S.E.S.352, S.E.S.356, Triton and a Bureau seedling N.10.

At present 19 varieties have made satisfactory growth in the House and will be distributed shortly. They include two local varieties as well as canes from Hawaii, Mauritius and Barbados.

Legumes

The breeding work with cowpeas described elsewhere in this Report is yielding many lines for selection but the possible influence of disease when these reach commercial propagation is still obscure. In the dry spring and light wet season of 1960-61, there was little evidence of the wilt diseases, but virus diseases tended to interfere with the evaluation of the strains. On the Northern Experiment Station infection with a mosaic was severe, while on the Mackay Station, heavy early infection occurred with the virus disease little leaf.

Pathology Farm

The Bureau Pathology Farm continues as an important part of the Division. It is situated in the Eight Mile Plains locality within the Greater Brisbane area and is some 11 miles from the centre of the City. A total of approximately 12 acres is covered by the Skinner sprinkler irrigation system and is available for cane cultivation. The rest of the 58 acres is chiefly under hardwood forest, although over eight acres have been planted with the exotic *Pinus elliotti*, which continues to make excellent growth. Resistance trials for downy mildew, Fiji, gumming, leaf-scald, mosaic, ratoon stunting and red-rot diseases are regularly conducted at the Farm with advanced seedlings from all parts of Queensland and any promising importations. Growth is usually adequate for trial purposes and it is felt that results give a fair indication of field behaviour to the various diseases. Apart from the trials, there are also plantings of experimental work with a range of items and an interesting miscellany of diseases and abnormalities collected from commercial crops throughout Queensland.

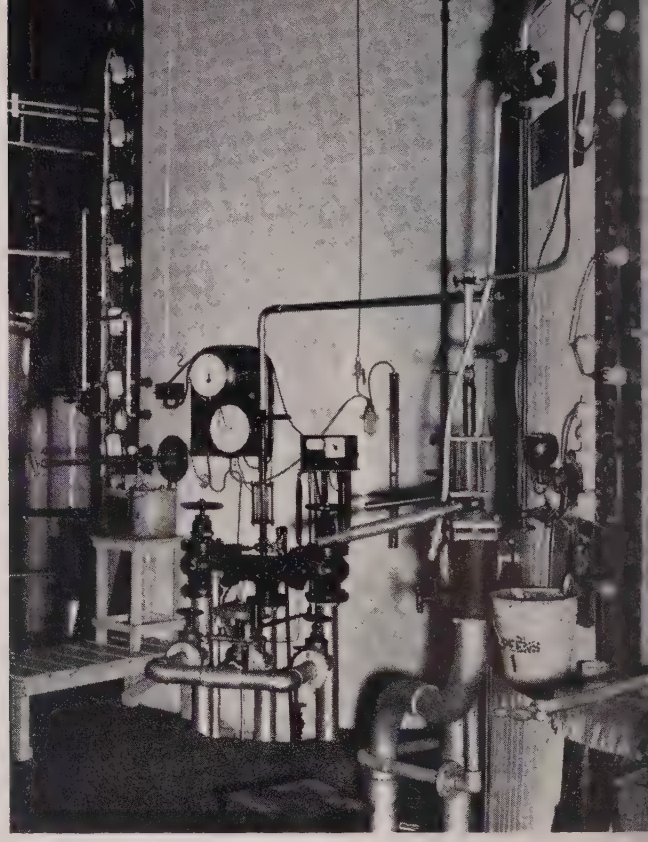
Overseas and interstate visitors to the Pathology Farm during the year included Dr. John T. Slykhuis, a cereal virus authority from Canada, Dr. D. J. Goodchild of the Commonwealth Scientific and Industrial Research Organization, Canberra, Australian Capital Territory, Mr. J. Wilson and Dr. P. G. C. Brett of the Experiment Station

of the South African Sugar Industry, Mr. P. A. Robinson of the Department of Agriculture, Kenya, and Mr. Kai-Min Wang of the Taiwan Sugar Corporation. In addition, members attending a school for senior Bureau field officers spent some time at the Farm.

Staff

Mr. C. D. Jones, a diplomate from the Queensland Agricultural High School and College, Gatton, joined the staff of the Division as a cadet in the Brisbane laboratory in January, 1961.

Mr. B. T. Egan, who is pathologist at the Northern Sugar Experiment Station, in January proceeded to Ceylon on an assignation under the Colombo Plan. After advising on disease matters in the newly established sugar industry in Ceylon he spent two weeks in India on a tour of laboratories and stations working on sugar cane. His contact with several diseases not known in Australia should be of great value to the Division.



The Webre pan and its instrumentation at Moreton.

Division of Mill Technology

L. R. Brain, Sen. Mill Technologist
Associated with
B. G. Adkins, Research Mill Technologist
A. D. Doolan, Labty. Technologist

Metrology

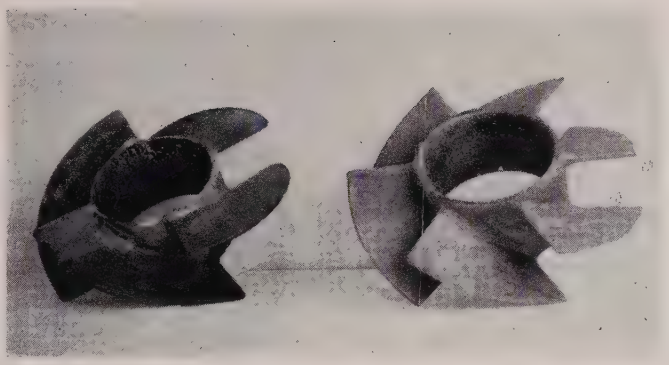
The checking of equipment for sugar mill laboratories continues to occupy an important position in the activities of the Technology Division. The accompanying table indicates the type of equipment and number of items checked during the year.

Type of Apparatus	*Number Tested*	*Number Certified*
Balances	2	2
Brix Hydrometers ..	539	467
Burettes	14	12
Flasks	201	185
Pipettes	87	73
Polariscope Tubes ..	63	61
Quartz Control Plates	4	4
Refractometers ..	11	9
Saccharimeters ..	10	10
Thermometers ..	92	80
Weights	53	40

An examination of this table indicates the continuing necessity for this service, as a significant number of items did not fulfil the requirements of accuracy laid down. Although this service has been in operation now for many years, much of the equipment used in mills has not been checked. A concerted effort is now being made to have all new equipment checked before delivery to mills. Later, equipment will be rechecked regularly to maintain its standard of accuracy.

As well as the checking for accuracy of such instruments as saccharimeters and refractometers, their repair is also undertaken in cases where it is warranted.

All the testing performed at the Bureau is now carried out under registration by the National Association of Testing Laboratories and the large majority of certificates issued are stamped to that effect. Besides being an Australia-wide Association, registration with N.A.T.A. involves frequent contacts with officers of the National Standards



Model impellers used for investigation into the efficiency of various designs in pans.

Laboratory, contacts which ensure that standardisation work is maintained at a high level.

Cane Analysis Investigations

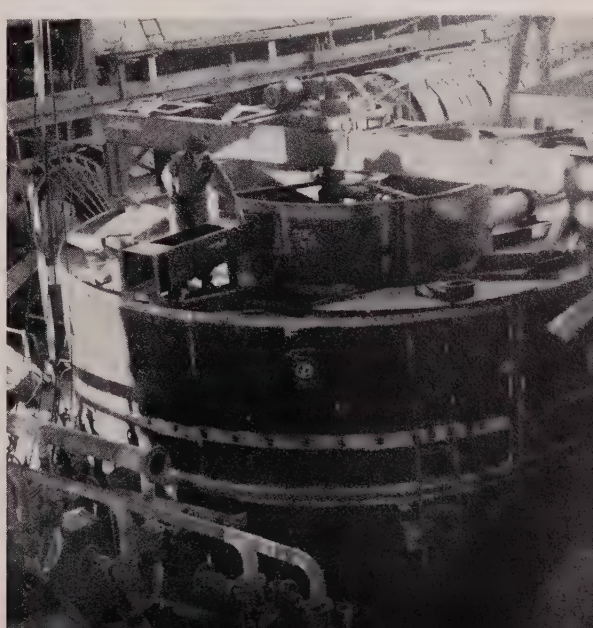
Under the direction of the Committee appointed by the Minister for Agriculture and Forestry, work continued on the cane analysis investigations, the majority of the staff being involved in this project. Reports on activities are regularly submitted to the Committee which in turn submits yearly reports to the Minister. During the year under review the Minister approved circulation throughout the industry of the Committee's report on the 1959 investigations. The report on the 1960 year's work is now complete.

Circulation in Vacuum Pans

Following the work in the 1959 season which indicated that the impeller in the Webre pan at Moreton mill could be operated at considerably higher speeds without overloading the motor, the speed was increased from 80 to 106 r.p.m. This speed fully loaded the motor at the end of the strike, and massecuite circulation rate was certainly improved, but localised boiling was still very evident and fine grain was still present in the finished strike.

An investigation of temperature conditions in the massecuite and in the steam space of the calandria was then undertaken and, contrary to expectations, the temperature of massecuite recorded at the top of the tubes was almost always lower than that at the bottom. This was rather incredible and the method of measurement was in some doubt and further work was indicated on this aspect. Consequently, for the time being massecuite temperatures were discarded as a means of assessing the heat transfer through individual tubes.

Temperatures in the steam space, however, proved to be quite interesting, readings being taken in the steam inlet to the pan, near the steam inlet in the calandria and at a point midway between the two steam inlets (which are diametrically opposed). The temperature in the calandria at the position away from the steam inlet agreed fairly well with that of saturated steam at calandria pressure, but the temperature at the steam inlet was up to 15°C higher, when



New Dorr Subsider at Bingera mill.

Bulk sugar bins at Moreton and the covered waggons used for transport to the refinery.

the pan was boiled with a steam at a vacuum of 4 to 6 in. Hg. in the calandria. It was apparent that under these conditions the steam admitted to the calandria was superheated by as much as 15°C and that this could be a reason for uneven heating and the consequent localised boiling.

Early in the investigation it was thought that inadequate venting of noxious gasses could be a factor; however, the temperature measured at points remote from the steam inlet did not fall below that of saturated steam at calandria pressure and venting therefore must be sufficient.

The provision of saturated steam throughout the calandria will be attempted during the 1961 season by spraying water into the steam line before the pan. It is expected that an improvement in more even circulation within the pan will result.

Entrainment Investigations

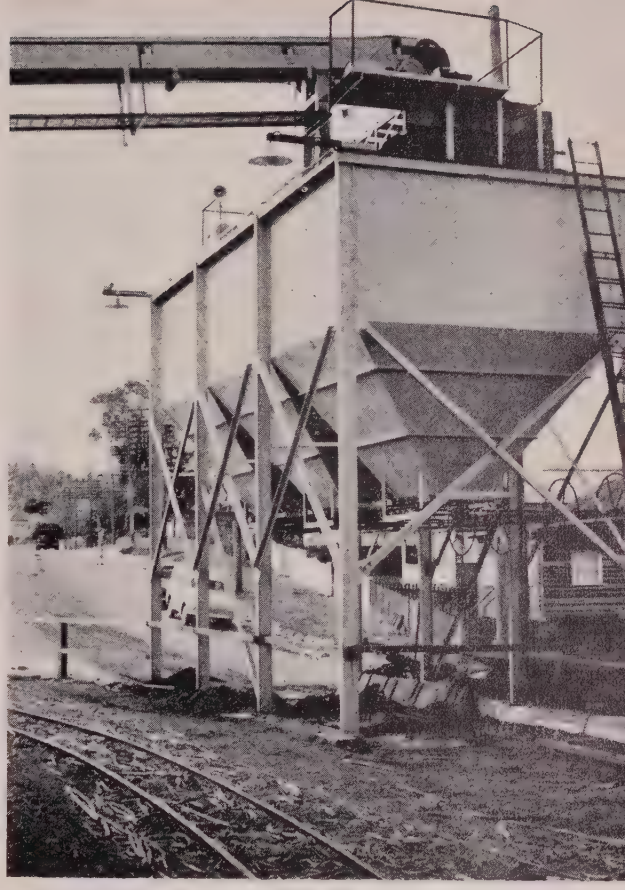
As a preliminary to an investigation of entrainment, a reliable method was sought for determining the concentration of sugar in dilute solution, and the arseno-molybdate method was adopted as the most reliable.

In the factory the entrainment from the effets at Gin Gin, Mourilyan and Moreton was examined. Sampling of vapour from the last vessel of one set of effets at Gin Gin showed that the position of the sampler in the vapour pipe was not critical and a maximum concentration of sugar of 250 p.p.m. was recorded. No relationship was apparent between entrainment and the operating variables of vacuum, syrup brix, boiling level and rate. It is apparent that the wood maze in the effets at Gin Gin is quite efficient and that this high efficiency would tend to mask the effect of these factors.

At Mourilyan, however, vapour sampling proved to be very dependent on the position of the sampling tube in the vapour pipe of the last vessel and it was therefore abandoned in favour of sampling the condenser water. The average sugar content of the condenser water was 20 p.p.m. which represents a loss of 1.0 to 1.2 tons of sugar per week. It was felt that, although a catchall and Halpin baffles are installed in this effet vessel, a wood maze would reduce the loss and its installation would be economic.

Again, no relationship was apparent between the entrainment and the operating variables, but when the entrainment from the previous vessels of the set was examined, it appeared that the volume of vapour given off from a vessel in unit time has the greatest effect on entrainment.

Condenser water was sampled at Moreton and, as the recirculated water already contained a fair concentration of sugar, the actual entrainment occurring was not determined with great accuracy. A maximum of 260 p.p.m. was determined for the



The filter mud hoppers at Moreton mill.

concentration of sugar in the vapour, which is quite low.

It appears that vapour sampling is generally desirable in this work, especially when condenser water is recirculated.

The investigation will continue during the 1961 season, when the efficiency of different types of entrainment preventer will be investigated.

Mill Visits

During the season, each mill was visited by at least one Bureau officer for general discussions on factory performance and modification or extension of existing equipment.

The 1960 Season

After the excellent 1959 season, the further improvement in conditions experienced during the 1960 season was somewhat of a surprise. Due to the low production of sugar in Mauritius, the mills were allowed to produce 8½ per cent in excess of their individual sugar peaks with a further allowable over-production of one half per cent. Although quantities of cane were still left unharvested, 1,319,633 tons of 94 n.t. sugar were produced from 8,685,426 tons of cane, a ratio of 6.58 tons of cane per ton of sugar which is the lowest figure on record.

Conditions were excellent for the production of high quality cane and the c.c.s. of 15.27 was 0.71 above that of the 1959 season. Significant increases were recorded in each of the four districts, with the northern district outstanding with an average increase of almost one unit of c.c.s. The fibre in cane showed a reversal of the trend experienced over the last few years, a rise from 12.95 to 13.36 being recorded. It is believed that dry weather and standover cane were largely responsible for this rise as, generally, the cane supply to the mills was clean.

Once again the season was a very short one, occupying only 4321 crop days, and the crushing time per cent available time showed an increase to 95.41. Dry weather contributed largely to this figure, as the lost time due to cane supply was only 1.33 per cent while lost time due to manufacture remained stationary at 3.26 per cent of available time.

Although there was little incentive for high crushing rates in an already short season, the average crushing rate did increase to 116.96 tons of cane per hour compared with 114.59 in 1959. A large rise of 9.64 tons per hour was recorded in the Burdekin area and four tons per hour in the northern area, while small rises occurred in Mackay and the southern districts. Some attention is being paid to milling trains especially with regard to feeding devices in mills; however, a drop in pol extraction was recorded from 95.00 to 94.69. Increases in ex-

traction were experienced in the northern and Burdekin areas while quite large decreases were found in the Mackay and southern areas. The average reduced extraction dropped by only 0.07, however, a small decrease which may have been due to the increased crushing rate.

While the true purity of final molasses did decrease to a small extent to 43.49, the decrease in the difference between actual purity and expected purity from 2.54 to 2.19 is more significant, and indicates a higher standard of work in pan boiling and fugalling operations. The sustained high purity of the material entering the factory continued to assist these operations in reduced throughput at the low grade massecuite stations.

Despite the increased crushing rate and decrease in extraction, the overall performance figures exhibited significant improvements, the overall recovery rising from 87.95 to 88.44 and the coefficient of work from 98.60 to 99.11. Losses in molasses and mud and undetermined losses all showed improvements, indicative of a high level of process factory control.

Sugar quality remained steady at the standard set during the 1959 season, although the dilution indicator did show some improvement.

Extraneous fuels burnt were reduced considerably from the quantities burnt in 1959. The excellent cane supply would be the principal factor in this reduction because it reduced stoppages due to lack of cane.

Overall, the operations of the 1960 season were rather phenomenal—a short season of high quality cane and excellent factory results. It is doubtless that the weather was chiefly responsible for the quality of the cane and it is too much to hope that such conditions will set a pattern for future seasons. The factory performance was very high despite low milling figures and perhaps it is in this department that effort could best be rewarded.

Entrainment preventer on effets at Bingera mill.

Table IX—Production Data for Queensland Mills for Seasons 1954-1960 (Totals and Weighted Averages)

Northern District	1954	1955	1956	1957	1958	1959	1960
Cane—							
Tons	3,943,427	3,270,354	3,197,051	3,699,279	3,882,644	3,461,833	3,477,314
Pol per cent	13.88	13.55	13.80	14.74	15.07	14.83	15.86
Fibre per cent	10.93	11.38	11.74	11.21	11.20	11.20	11.59
C.c.s.	12.70	12.36	12.67	13.99	14.06	14.15	15.16
Purity 1st expressed juice	87.20	86.96	87.71	89.11	89.07	89.72	90.68
Sugar							
Tons 94 net titre	502,276	413,853	406,172	516,345	540,476	485,660	525,405
Cane per ton sugar	7.85	7.90	7.87	7.16	7.18	7.13	6.62
Pol per cent	98.50	98.60	98.78	98.66	98.36	98.40	98.40
Net titre	97.09	97.33	97.61	97.30	96.67	96.58	96.50
Dilution indicator	30.5	41.0	38.5	36.0	37.3	38.7	36.3
Pol per cent pol cane	85.17	84.67	86.32	87.69	87.17	87.22	89.11
Mud—							
Tons	63,816	54,285	53,324	57,489	57,210	50,508	52,284
Mud per cent cane	2.96	3.07	3.19	2.90	2.72	2.64	2.77
Pol per cent	2.96	3.47	2.40	2.54	2.05	2.12	1.98
Pol per cent pol cane	0.64	0.79	0.55	0.50	0.37	0.38	0.34
Molasses—							
Gallons (1,000's)	10,246	8,243	7,416	8,001	8,981	7,353	6,922
Gallons per ton cane	4.76	4.66	4.43	4.04	4.28	3.85	3.66
Brix	89.78	91.38	90.29	90.60	90.58	90.66	90.96
Apparent purity	32.49	31.87	30.05	30.76	29.16	30.77	31.74
True purity	44.31	44.40	41.82	42.77	41.67	42.94	43.87
Expected purity	38.0	38.4	37.8	38.34	37.58	38.97	39.55
Reducing sugars/ash	..	1.90	2.12	1.87	2.23	1.66	1.48
Pol per cent pol cane	6.74	6.79	5.76	5 06	4.96	4.80	4.43
Final Bagasse—							
Tons	489,784	421,275	404,825	461,292	490,452	441,466	440,859
Bagasse per cent cane	22.74	23.83	24.19	23.30	23.35	23.11	23.34
Pol per cent	2.63	2.55	2.37	2.99	3.38	3.01	3.07
Dry substance	51.55	51.39	51.69	52.08	52.02	52.64	53.75
Pol per cent pol cane	4.31	4.48	4.15	4.72	5.24	4.69	4.52
Undetermined loss—							
Pol per cent pol cane	3.14	3.47	3.22	2.03	2.26	2.91	1.60
Fuels—							
Tons: Wood	3,498	4,909	9,691	6,300	5,899	6,392	2,530
Coal	40	42	111	71	96	175	143
Molasses	6,982	9,093	9,183	1,842	736	1,317	873

Burdekin District	1954	1955	1956	1957	1958	1959	1960
Cane—							
Tons	1,503,156	1,255,985	1,303,889	1,382,125	1,387,269	1,206,774	1,266,237
Pol per cent	15.84	15.87	15.50	16.35	15.89	16.45	16.73
Fibre per cent	11.55	11.67	12.40	12.15	11.70	12.11	11.90
C.c.s.	14.71	14.70	14.45	15.21	14.72	15.22	15.57
Purity first expressed juice	89.23	88.76	89.70	89.77	88.91	89.05	89.94
Sugar—							
Tons 94 net titre	218,505	179,664	184,607	208,250	204,812	182,211	197,705
Cane per ton sugar	6.88	6.99	7.06	6.64	6.77	6.62	6.40
Pol per cent	98.82	98.65	98.72	98.52	98.83	98.80	98.75
Net titre	97.23	96.96	96.93	96.38	96.92	96.74	96.76
Dilution indicator	29.5	35.0	31.0	32.4	31.3	30.8	32.3
Pol per cent pol cane	87.65	86.20	87.47	88.56	89.03	88.12	89.33
Mud—							
Tons	54,491	44,066	46,074	52,525	59,486	47,833	48,262
Mud per cent cane	3.63	3.51	3.53	3.80	4 29	3.96	3.81
Pol per cent	2.07	1.82	1.87	1.83	1.59	1.78	1.72
Pol per cent pol cane	0.47	0.40	0.43	0 43	0.43	0.43	0.39
Molasses—							
Gallons (1,000's)	6,652	5,761	5,623	6,143	6,169	5,782	5,569
Gallons per ton cane	4.43	4.59	4.31	4.44	4.45	4.79	4.40
Brix	91.84	91.10	91.31	92.31	90 05	91.08	91.90
Apparent purity	34.93	34.94	35.76	34.54	32.78	34.03	32.70
True purity	45.22	44.62	45.24	44.21	42.47	43.91	43.29
Expected purity	41.19	41.03	41.06	41.83	41.01	41.33	41.74
Reducing sugars/ash	..	1.19	1.15	0.99	1.20	1.11	1.09
Pol per cent pol cane	6.12	6.18	6.04	5.79	5.46	6.00	5.27
Final Bagasse—							
Tons	340,976	294,263	312,732	331,460	318,499	290,011	299,581
Bagasse per cent cane	22.68	23.43	23.98	23.98	22.96	24.03	23.66
Pol per cent	3.08	3.17	2.77	3.19	3.13	3.22	3.14
Dry substance	53.87	53.55	55.28	54.68	54.97	54.50	54.61
Pol per cent pol cane	4.49	4.69	4.30	4.68	4.53	4.71	4.44
Undetermined Loss—							
Pol per cent pol cane	1.27	2.53	1.76	0.54	0.55	0.74	0.57
Fuels—							
Tons: Wood	2,124	2,150	3,521	1,837	928	704	480
Coal	69	39	353	0	233	0	0
Molasses	0	0	0	238	0	0	0

Table IX—continued.

Mackay District	1954	1955	1956	1957	1958	1959	1960
Cane—							
Tons	2,616,619	2,386,011	2,462,019	2,702,060	2,563,034	2,083,692	2,170,057
Pol per cent	14.94	15.40	14.84	15.46	15.43	16.22	16.91
Fibre per cent	14.40	15.12	15.02	14.77	14.53	14.32	14.75
C.c.s.	13.87	14.22	13.71	14.33	14.29	15.17	15.83
Purity first expressed juice	89.54	88.85	88.97	89.60	89.28	90.72	90.82
Sugar							
Tons 94 net titre	352,362	329,482	323,631	378,793	359,112	315,391	341,325
Cane per ton sugar	7.43	7.24	7.61	7.13	7.14	6.61	6.36
Pol per cent	98.97	98.86	98.88	98.68	98.71	98.71	98.71
Net titre	97.79	97.57	97.59	97.04	97.07	96.93	96.94
Dilution indicator	26.8	34.3	33.9	29.7	32.6	32.7	32.0
Pol per cent pol cane	85.74	85.40	84.34	86.70	86.77	89.31	89.05
Mud—							
Tons	90,671	84,049	90,763	103,938	97,889	73,997	80,454
Mud per cent cane	3.47	3.52	3.69	3.85	3.82	3.55	3.71
Pol per cent	2.91	2.92	2.72	2.83	2.91	2.87	2.84
Pol per cent pol cane	0.68	0.66	0.67	0.70	0.72	0.63	0.62
Molasses—							
Gallons (1,000's)	11,575	11,917	10,592	10,456	10,370	8,014	8,348
Gallons per ton cane	4.42	4.99	4.30	3.87	4.05	3.85	3.85
Brix	89.17	90.86	89.73	90.85	90.24	90.55	90.54
Apparent purity	36.07	34.53	36.25	34.10	33.32	33.13	33.38
True purity	43.60	42.89	43.53	41.92	41.29	41.59	42.27
Expected purity	40.45	39.99	40.25	40.62	40.04	40.50	40.96
Reducing sugars/ash	..	1.40	1.32	1.26	1.42	1.31	1.21
Pol per cent pol cane	5 92	6.33	6.22	5.15	5.22	4.71	4.55
Final Bagasse—							
Tons	775,206	757,762	785,458	834,597	773,958	597,019	644,103
Bagasse per cent cane	29.63	31.76	31.90	30.89	30.20	28.65	29.68
Pol per cent	2.70	2.76	2.60	2.91	2.97	2.81	3.23
Dry substance	52.14	51.41	51.17	51.51	51.89	53.81	53.93
Pol per cent pol cane	5.35	5.70	5.60	5.81	5.81	4.96	5.67
Undetermined Loss—							
Pol per cent pol cane	2.31	1.91	3.17	1.64	1.48	0.39	0.11
Fuels—							
Tons: Wood	1,470	1,903	2,852	1,136	1,505	859	655
Coal	12	0	50	114	0	14	8
Molasses	0	0	0	0	0	0	0

Southern District	1954	1955	1956	1957	1958	1959	1960
Cane—							
Tons	1,801,103	1,703,813	2,015,122	1,162,153	1,907,848	1,675,432	1,771,818
Pol per cent	14.08	14.12	14.29	14.91	14.60	15.26	15.78
Fibre per cent	14.77	14.70	14.17	14.61	14.09	13.85	14.57
C.c.s.	12.91	12.89	13.12	13.68	13.38	14.17	14.58
Purity first expressed juice	87.80	87.22	87.81	87.90	88.03	89.38	88.72
Sugar—							
Tons 94 net titre	228,102	212,676	257,460	152,883	249,143	233,758	255,198
Cane per ton sugar	7.90	8.01	7.83	7.60	7.66	7.17	6.94
Pol per cent	99.00	98.83	98.57	98.49	98.74	98.79	98.83
Net titre	97.68	97.26	96.64	96.44	96.88	96.88	97.03
Dilution indicator	32.8	35.9	34.8	33.5	32.0	33.3	30.5
Pol per cent pol cane	85.82	84.58	85.75	84.92	85.81	87.66	87.39
Mud—							
Tons	65,650	61,903	71,324	44,428	70,727	64,289	74,678
Mud per cent cane	3.70	3.69	3.59	3.92	3.81	3.84	4.21
Pol per cent	2.73	2.91	3.08	2.89	2.75	2.74	2.39
Pol per cent pol cane	0.72	0.76	0.77	0.76	0.72	0.69	0.64
Molasses—							
Gallons (1,000's)	7,248	7,708	8,117	5,117	8,225	6,270	7,707
Gallons per ton cane	4.09	4.59	4.09	4.52	4.43	3.74	4.35
Brix	91.57	91.84	91.99	91.51	91.45	91.37	91.78
Apparent purity	36.13	36.10	36.62	37.57	36.13	37.10	35.89
True purity	43.00	44.38	45.00	45.55	44.94	45.46	44.41
Expected purity	42.00	42.60	42.8	42.39	42.29	42.83	42.25
Reducing sugars/ash	..	0.88	0.90	0.90	0.93	0.81	0.96
Pol per cent pol cane	6.42	7.34	6.42	6.94	6.66	5.52	6.04
Final Bagasse—							
Tons	567,691	518,682	588,925	355,219	544,456	479,739	536,175
Bagasse per cent cane	32.00	30.91	29.66	31.37	29.30	28.63	30.26
Pol per cent	2.41	2.45	2.78	2.72	2.61	2.67	2.94
Dry substance	49.29	50.73	50.89	50.06	51.29	51.71	52.02
Pol per cent pol cane	5.48	5.35	5.77	5.72	5.24	5.01	5.64
Undetermined Loss—							
Pol per cent pol cane	1.56	1.90	1.29	1.66	1.57	1.12	0.29
Fuels—							
Tons: Wood	4,595	4,332	2,693	3,374	2,998	1,808	1,891
Coal	308	108	99	152	131	18	4
Molasses	0	0	0	0	0	0	0

Table IX—continued.

All Queensland Districts	1954	1955	1956	1957	1958	1959	1960
Cane—							
Tons	9,864,305	8,616,163	8,978,081	8,945,617	9,740,795	8,427,731	8,685,426
Pol per cent	14.64	14.72	14.58	15.34	15.22	15.64	16.32
Fibre per cent	13.02	13.48	13.59	13.26	13.05	12.95	13.36
C.c.s.	13.50	13.53	13.45	14.24	14.08	14.56	15.27
Purity first expressed juice	88.47	87.97	88.49	89.21	88.90	89.82	90.10
Sugar—							
Tons 94 net titre	1,301,245	1,135,675	1,171,870	1,256,271	1,353,543	1,217,020	1,319,633
Cane per ton sugar	7.58	7.59	7.66	7.12	7.20	6.92	6.58
Pol per cent	98.83	98.75	98.75	98.61	98.65	98.66	98.67
Net titre	97.47	97.33	97.22	96.88	96.89	96.79	96.81
Dilution indicator	29.9	36.5	35.0	32.5	33.8	34.4	33.0
Pol per cent pol cane	86.00	85.20	85.72	87.07	87.07	88.15	88.71
Mud—							
Tons	274,628	244,303	261,485	258,380	285,312	236,627	255,678
Mud per cent cane	3.41	3.45	3.52	3.59	3.61	3.44	3.60
Pol per cent	2.71	2.84	2.60	2.57	2.42	2.46	2.32
Pol per cent pol cane	0.63	0.66	0.63	0.60	0.57	0.54	0.51
Molasses—							
Gallons (1,000's)	35,721	33,629	31,748	29,717	33,745	27,419	28,546
Gallons per ton cane	4.44	4.74	4.28	4.13	4.27	3.99	4.02
Brix	90.34	91.25	90.72	91.20	90.59	90.88	91.24
Apparent purity	34.84	34.31	34.81	33.89	32.80	33.60	33.53
True purity	43.98	43.90	43.80	43.25	42.50	43.33	43.44
Expected purity	40.20	40.40	40.4	40.56	40.11	40.80	41.12
Reducing sugars/ash	..	1.32	1.30	1.26	1.40	1.21	1.17
Pol per cent pol cane	6.28	6.63	6.14	5.53	5.52	5.16	5.01
Final Bagasse—							
Tons	2,173,657	1,991,982	2,091,940	1,982,568	2,127,365	1,808,235	1,920,718
Bagasse per cent cane	27.01	28.10	28.18	27.55	26.90	26.30	27.06
Pol per cent	2.67	2.69	2.63	2.94	3.00	2.89	3.10
Dry substance	51.53	51.54	51.81	51.91	52.23	53.08	53.46
Pol per cent pol cane	4.94	5.15	5.09	5.28	5.30	4.85	5.14
Undetermined Loss—							
Pol per cent pol cane	2.15	2.38	2.42	1.52	1.54	1.30	0.63
Fuels—							
Tons: Wood	11,687	13,294	18,757	12,647	11,330	9,763	5,556
Coal	1,152	189	613	337	460	207	155
Molasses	6,982	9,093	9,183	2,080	736	1,317	873

Tons of cane, tons of sugar, tons of cane per ton of sugar and c.c.s. (from 1957), include all mills. All other figures exclude C.S.R. and Rocky Point Mills. (Rocky Point figures included from 1959).

Table X

Tons of Cane per Ton 94 Net Titre Sugar, 1951-1960

Season	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Tons Cane per ton 94 n.t. Sugar	7.11	7.32	7.17	7.58	7.59	7.66	7.12	7.20	6.92	6.58

Table XI

Sugar Produced in Districts, 1960 Season, with Peak Allocations

Districts	Tons 94 Net Titre Sugar			Production per cent Peak
	Produced	Peak	Excess Production over Peak	
Northern	525,405	485,400	40,005	108.24
Burdekin	197,705	181,700	16,005	108.81
Mackay	341,325	313,500	27,825	108.88
Southern	255,198	234,000	21,198	109.06
All Districts	1,319,633	1,214,600	105,033	108.65

Table XII

Figures for 1960 Season (Totals and Arithmetic Averages)

—	Northern	Burdekin	Mackay	Southern	All Districts
Tons Cane Crushed	3,477,314	1,266,237	2,170,057	1,771,818	8,685,426
Tons 94 N.T. Sugar made	525,405	197,705	341,325	255,198	1,319,633
Net Titre of Sugar	96.44	96.83	96.95	96.95	96.82
Tons Cane per ton 94 N.T. Sugar	6.66	6 41	6.36	6.97	6.64
C.c.s. of Cane	15.09	15.60	15.81	14.63	15.21
Coefficient of Work	99.25	100.08	99.46	98.27	99.11
Coefficient of Work E.S.G.	94.71	95.52	94.83	93.79	94.56
Crushing Rate	133.03	128.91	128.18	90.98	116.96
Lost Time per cent Available Time	7.10	4.22	2.66	4.60	4.52
Fibre of Cane	11.55	12.15	14.73	14.72	13.63
Pol of Cane	15.85	16.76	16.89	15.82	16.28
First Expressed Juice					
Brix	20.97	22.52	23.17	22.19	22.26
Purity	90.66	89.93	90.81	88.80	89.98
Purity—					
Clarified Juice	90.06	88.86	89.87	87.93	89.11
Syrup	90.06	89.71	89.72	88.28	89.36
Dilution per cent First Expressed Juice	24.89	29.97	33.94	37.26	32.45
Final Bagasse					
Pol	3.07	3.14	3.19	3.03	3.10
Dry Substance	53.82	54.61	53.77	52.27	53.40
Pol Extraction	95.49	95.42	94.37	94.11	94.69
Reduced Extraction	95.08	95.30	95.35	95.15	95.21
Final Molasses—					
Gallons per ton Cane	3.67	4.45	3.89	4.35	4.08
Brix	90.88	91.66	90.40	91.19	90.96
Apparent Purity	31.61	33.11	33.42	35.99	33.83
True Purity	43.65	43.89	42.29	44.28	43.49
Expected Purity	39.60	41.65	41.01	42.39	41.30
Reducing Sugars/Ash	1.49	1.13	1.21	0.96	1.17
Final Mud—					
Per cent Cane	2.75	3.63	3.78	4.28	3.69
Pol per cent Mud	1.98	1.71	2.72	2.43	2.31
Sugar—					
Pol	98.37	98.70	98.72	98.81	98.67
Reducing Sugars	0.42	0.33	0.33	0.26	0.33
Ash	0.30	0.34	0.29	0.32	0.31
Moisture	0.44	0.32	0.31	0.28	0.33
Dilution Indicator	36.2	32.8	32.4	30.3	32.6
Pol Balance—					
Sugar (Recovery)	89.14	89.24	89.11	87.02	88.44
Bagasse Loss	4.52	4.58	5.63	5.89	5.31
Molasses Loss	4.41	5.36	4.61	6.01	5.14
Mud Loss	0.34	0.38	0.61	0.63	0.52
Undetermined Loss	1.59	0.44	0.04	0.45	0.59
Recovery overall E.S.G.	88.70	88.89	88.76	86.70	88.08
Recovery on mixed juice	93.36	93.51	94.43	92.46	93.40
Recovery on mixed juice E.S.G.	92.91	93.15	94.06	92.12	93.02
Boiling House Efficiency	97.37	97.91	98.41	97.38	97.76
Boiling House Efficiency E.S.G.	96.90	97.52	98.03	97.02	97.36
Fuels (as equivalent Bagasse per cent Cane)—					
Wood	0.24	0.07	0.06	0.18	0.14
Coal	0.05	0.00	0.00	0.00	0.01
Molasses	0.07	0.00	0.00	0.00	0.02
Total added	0.36	0.07	0.06	0.18	0.17
Bagasse	25.60	27.18	32.67	32.36	30.18
Total Fuel	25.96	27 25	32.73	32.54	30.35
Crop Days	1,558	613	995	1,155	4,321

Tons of cane, tons of sugar, tons of cane per ton of sugar, c.c.s. of cane and crop days include all mills. All other figures exclude C.S.R. Mills.

Table XIII

Cane Milled and Sugar Yielded, 1960 Season

Mills	Tons Cane Crushed	*Tons 94 n.t. Sugar made	Tons Cane per ton Sugar	
			1960	1959
Mossman	231,124	33,725	6.853	7.007
Hambledon	324,176	51,627	6.279	6.951
Mulgrave	342,072	51,777	6.607	7.334
Babinda	348,637	50,330	6.927	7.742
Goondi	279,063	41,047	6.799	7.488
Mourilyan	251,806	36,959	6.813	7.496
South Johnstone	362,440	53,560	6.767	7.323
Tully	353,042	52,248	6.757	7.408
Victoria	628,212	98,002	6.410	6.673
Macknade	356,742	56,130	6.356	6.456
Northern District Totals and Averages	3,477,314	525,405	6.618	7.128
Invicta	190,152	29,346	6.480	6.506
Pioneer	321,228	51,305	6.261	6.509
Kalamia	342,628	53,270	6.432	6.632
Inkerman	412,229	63,784	6.463	6.761
Burdekin District Totals and Averages	1,266,237	197,705	6.405	6.623
Proserpine	318,526	49,104	6.487	6.991
Farleigh	309,332	47,450	6.519	6.681
Racecourse	302,369	47,944	6.307	6.521
Pleystowe	304,918	49,226	6.194	6.360
Marian	289,249	45,723	6.326	6.697
Cattle Creek	167,953	25,550	6.574	6.870
North Eton	176,273	28,328	6.223	6.349
Plane Creek	301,437	48,000	6.280	6.404
Mackay District Totals and Averages	2,170,057	341,325	6.358	6.607
Fairymead	284,107	40,728	6.976	7.089
Qunaba	140,984	21,356	6.602	6.990
Millaquin	270,704	40,528	6.679	6.828
Bingera	296,890	42,459	6.992	7.122
Gin Gin	125,402	16,913	7.415	7.289
Isis	304,913	42,939	7.101	7.526
Maryborough	148,755	21,809	6.821	7.237
Moreton	153,686	21,930	7.008	7.218
Rocky Point	46,377	6,536	7.096	7.619
Southern District Totals and Averages	1,771,818	255,198	6.943	7.167
All Districts Totals and Averages	8,685,426	1,319,633	6.582	6.924

*Local Sales included

Table XIV

Analysis of Gross Time, 1960 Season, excluding C.S.R.

	Total Hours	Per Cent Gross Total Hours	Per Cent of Available Hours
Crushing Time	59,713.01	67.88	95.41
Lost Time—			
Manufacture	2,037.90	2.32	3.26
Cane Supply	835.83	0.95	1.33
Total Available Hours	62,586.74	71.15	100.00
Premeditated and Week-end Stops	25,378.62	28.85	
Gross Total Hours	87,965.36	100.00	

Table XV

***Fuels Calculated as Equivalent Bagasse Per Cent Cane, 1954-1960**
(Arithmetic Averages)

Year	Wood	Coal, etc.	Molasses	Total Added	Bagasse	Total Fuel
NORTHERN DISTRICT						
1954	0.308	0.008	0.434	0.750	23.952	24.702
1955	0.550	0.010	0.627	1.187	24.945	26.132
1956	1.057	0.025	0.777	1.859	25.402	27.261
1957	0.597	0.011	0.125	0.733	24.753	25.487
1958	0.540	0.017	0.045	0.602	24.618	25.220
1959	0.637	0.035	0.110	0.782	24.740	25.522
1960	0.235	0.052	0.075	0.362	25.601	25.963
BURDEKIN DISTRICT						
1954	0.308	0.015	..	0.323	25.455	25.778
1955	0.380	0.010	..	0.390	26.163	26.553
1956	0.553	0.090	..	0.643	27.523	28.166
1957	0.330	..	0.040	0.370	27.505	27.875
1958	0.123	0.055	..	0.178	26.530	26.708
1959	0.160	..	..	0.160	27.393	27.553
1960	0.070	..	..	0.070	27.180	27.250
MACKAY DISTRICT						
1954	0.115	0.001	..	0.116	31.401	31.517
1955	0.164	..	..	0.164	32.895	33.059
1956	0.213	0.006	..	0.219	32.961	33.180
1957	0.083	0.013	..	0.095	32.188	32.283
1958	0.123	..	..	0.123	31.618	31.741
1959	0.091	0.004	..	0.095	31.470	31.565
1960	0.063	..	..	0.063	32.673	32.736
SOUTHERN DISTRICT						
1954	0.845	0.044	..	0.889	31.767	32.656
1955	0.774	0.017	..	0.791	31.980	32.771
1956	0.378	0.012	..	0.390	30.806	31.196
1957	1.480	0.036	..	1.516	31.473	32.989
1958	0.425	0.021	..	0.446	30.598	31.044
1959	0.248	0.003	..	0.251	30.284	30.535
1960	0.184	..	..	0.184	32.357	32.541
ALL QUEENSLAND DISTRICTS						
1954	0.414	0.018	0.100	0.532	28.880	29.412
1955	0.474	0.009	0.145	0.628	29.743	30.371
1956	0.510	0.025	0.179	0.714	29.717	30.431
1957	0.669	0.017	0.035	0.722	29.532	30.253
1958	0.312	0.019	0.010	0.341	28.906	29.247
1959	0.275	0.010	0.024	0.309	28.975	29.284
1960	0.143	0.011	0.017	0.171	30.182	30.353

*Excluding C.S.R. mills.

Table XVI

Total Crop Days, All Mills, 1951-1960

——	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total Crop Days	4,089	5,046	5,515	6,110	5,397	5,605	4,690	4,990	4,394	4,321

Average Crushing Rates, 1951-1960, excluding C.S.R. and Rocky Point Mills (1951-58) Rocky Point included from 1959. (Arithmetic Averages)

——	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Tons Cane per hour	71.47	78.28	87.15	93.51	97.20	102.25	109.46	113.99	114.59	116.96

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